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THE PRACTICAL ENGINEER

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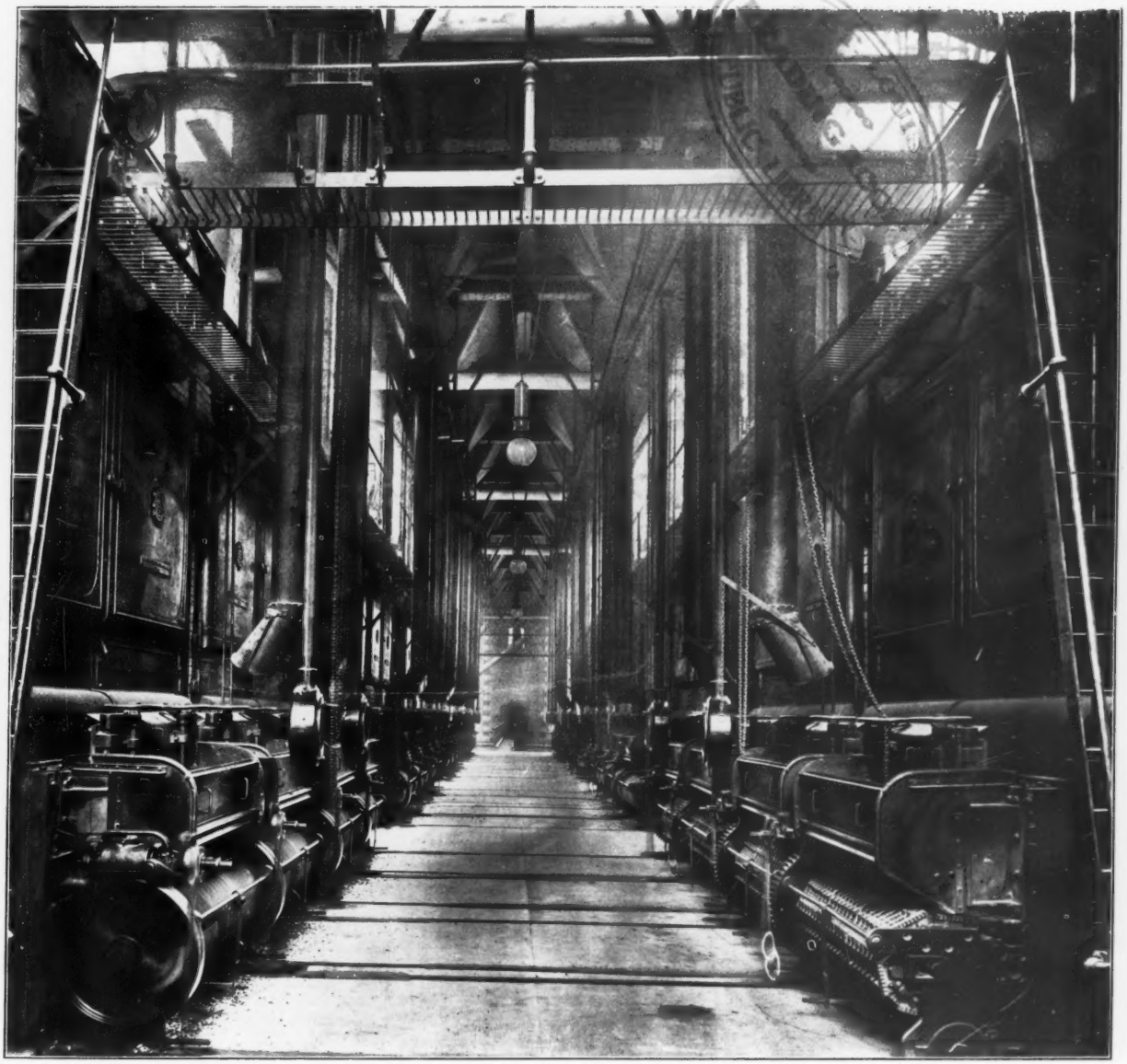

Interior of Boiler Room, Pinkston Generating Station, Glasgow, Scotland.

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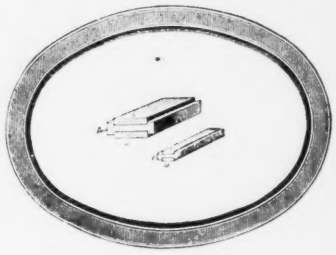

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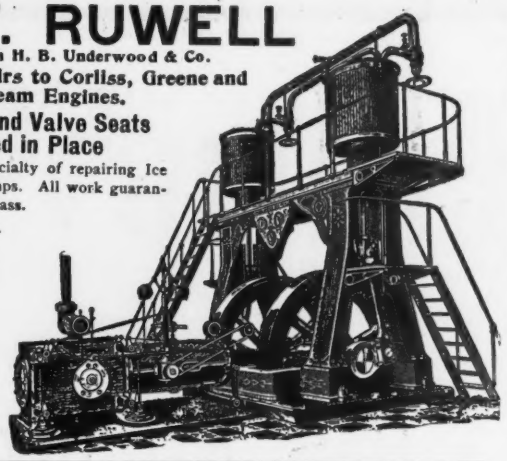

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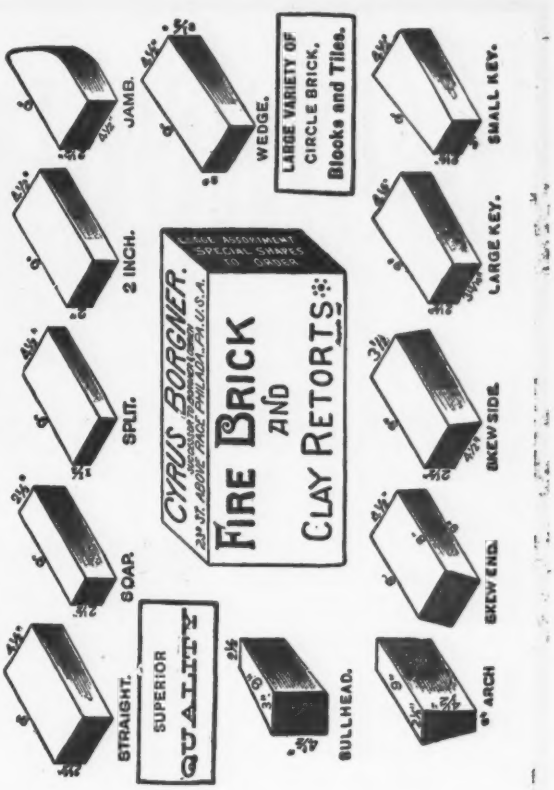

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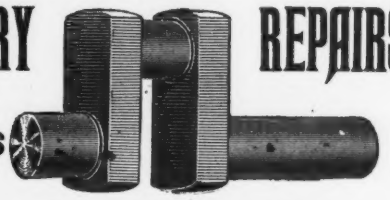

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Practical Engineer

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THE GREAT BALTIMORE FIRE

Some Impressions and Views Taken By An Engineer

On the morning of February 7th there occurred in Baltimore a disaster, the extent of which has astounded and awed the people of this country. Acre after acre in the very heart of the city in which the finest and largest building

Views taken from Jones Falls, showing extent of Fire.
Burned Continental Trust Building in distance.

stood, was burned over. Eighty city blocks are in ruins and 2500 buildings are destroyed. These included office buildings, banks, trust companies, wholesale and retail houses and a portion of one of the largest power houses of the South. It was a scene that one dreaded to look upon and never can the visitor forget this blackened, depressing sight and no smile was seen upon a countenance in the entire city. In only one other fire did the money loss of about $100,000,000 exceed this and that was when Chicago was swept away by flames in 1871, but Chicago of 1871 was a different city from the Baltimore of 1904.

Then there were no relics of the disaster like those which Baltimore contains. Chicago contained at that time no large buildings of any size but in Baltimore it was different. All through the burned district the massive skeletons of architectural giants remain. Hundreds of ugly looking frames of steel, with blackened bricks clinging to them, make a forbidding sight. After the fire had been checked, the walls are said to have resembled coke ovens with tongues of flames leaping from them. Tangled masses of wire crossed and recrossed the streets and as the writer was walking through the district, a few days after the fire, crumbling walls were still swaying in the wind endangering the life of those who ventured too close.

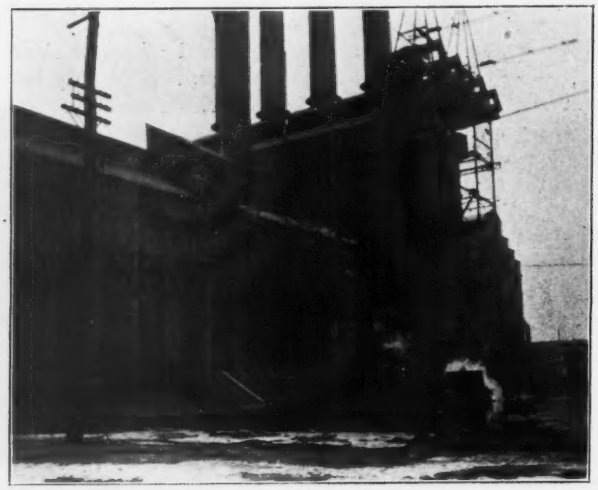
The fire began at about 11 o'clock on Sunday morning in the store of Hurst & Co., at Hopkins Place. The cause of the fire is unknown. Shortly after it began, there was an explosion of a gasoline tank on the third floor which

A Group of Chimneys left Standing

blew out part of the street wall and sent the flames roaring through the building and out across the street. The flames then spread rapidly, as a 30 mile an hour breeze was blowing. Inside of half an hour a dozen buildings were burning

and before an hour had elapsed, the force of the calamity was realized and outside aid was telegraphed for. Companies of firemen from Washington, Annapolis, Wilmington, Chester, Philadelphia, York and New York answered the call and for 27 hours helped the Baltimore firemen save their own city. Dynamiting of buildings was resorted to, in the hope that the course of the fire could be checked, but this proved futile. The flames leaped over these ruins made to check them. Steel and fireproof buildings were swept away the same as buildings built a century ago and 16-story buildings collapsed the same as smaller ones. One of the freaks of the fire was the saving of the United States warehouse. All the buildings in the neighborhood were destroyed, but this one escaped. Only three stories high, it stands almost uninjured while skyscrapers supposed to be fireproof which surrounded it are masses of ruins.

Towards six o'clock on the morning of the 8th the fire approach Jones' Falls, a canal about 250 feet wide, running through the city. The large electric railway power station is situated here. It consists of three buildings. The high centre building contains the boiler, pumps, condensers, the coal being hauled from canal boats to the upper floors by means of cranes. This portion of the power house



The Electric Railway Power House, partly destroyed by the fire.

was untouched. On the north of the boiler room was the older part of the station that was destroyed. It contained three large cross compound vertical McIntosh & Seymour engines, directly connected to multipolar generators, three horizontal McIntosh & Seymour engines each directly connected to two twin generators having a capacity of 800 amperes, when running at a speed of 200 revolutions per minute. The other engines and dynamos that were destroyed consisted of belted units, the dynamos of which are still standing.

The acompanying pictures of the burned power house were taken under great difficulty as bricks and portions of the buildings were falling constantly. When the fire struck the burned portion, the large steam main broke about six o'clock in the morning and if the Baltimore people remember anything besides the fire, they will remember the terrible noise that vibrated throughout the city due to this escaping steam under high pressure. Coming as it did from within the burned district, the frightened populace were more terrified than ever. It was heard miles away and lasted a long time. One of the accompanying pictures shows the steam pipe with the steam still escaping. The unburned portion of the power house which has recently been built is situated on the other side of the high boiler room and for this reason the flames did not injure it. This portion of the power house is now running the car lines of Baltimore.

One of the McIntosh and Seymour Horizontal Engines in the burned Power House,

The stations of the United Electric Light and Power Company, which supplies the lighting of the city, were not destroyed, although the new McClellan St. station is surrounded by the walls of the building which the fire levelled to the ground. The only damage to it was caused by the falling of the walls on the opposite side of the street. The electrical machinery was not injured by the water as they had been covered with tarpaulins.

Among many of the curious things that happened after the fire, the burning of the contents of the safe, shown in

One of the three Vertical Cross Compound Engines in the burned Power House.

the acompanying photographs, is one. This safe was buried beneath the ruins in the central part of the city and was still very hot when pulled out by a six horse team. The safe was filled with watches, rings and jewelry and the

owner was impatient to see if the contents of his safe were unimpaired. The locks were knocked off and the doors opened. There was a flash similar to an explosion and the contents of the safe were all burned. The safe before the fire contained cold air which expanded when the safe got hot. This expansion created a pressure which was probably considerable. The safe being hermetically sealed, combustion could not be supported no matter what the temperature, but when the safe was opened the temperature and pressure still being very high, the contents ignited and were rapidly burned. The writer witnessed the opening of the safe and the burning of its contents.

The effect of the heat upon the marble and granite buildings was interesting in the extreme. The back of the court house was assailed by the flames which seemingly almost melted the marble. This side is ruined so far as beauty is concerned, as big pieces of granite were broken off to the depth of six or eight inches and in other places was badly blistered. The two largest office buildings which were swept by the flames are still standing but it is a question whether they must not be torn down. These sky-scrapers were fireproof but not heatproof . The walls and ceilings

A silent witness in the district where the fire started.

and floors did not burn, but they warped and twisted, being surrounded with the intense heat. In some of the buildings, I-beams and channels were bent in circles. In fact, the only material which seemed to resist the fire was the brick, as many solitary brick chimneys still standing indicate.

Had the fire crossed Jones' Falls, the residence part of Baltimore would probably have been destroyed. The banks of the creek on both sides for a quarter of a mile were almost entirely lined with engines. At one time over 400 streams were playing on the fire. It was late on Monday afternoon of the 8th when the fire was brought under control and had the strong wind not shifted it would not have been conquered then. Tuesday morning saw the fire practically extinguished and the city under military guard. This fire was remarkable in another way. Not one person was killed. The reason for this is that the fire began on Sunday when the large factories, wholesale houses and office buildings were empty. Had the beginning of the fire been twenty-four hours later the loss of life would have been enormous. It is estimated that 50,000 persons are thrown out of work.

Three belted Generators in the ruined portion of the Power House, showing broken Steam Pipe.

Storage Batteries.

The voltage of a storage battery is usually on an average about 2 volts. On discharging, the electromotive force should not be allowed to fall below 1.8 volts. When the

A Fireproof Safe, whose contents burned after being opened.

batteries are charged, it should be done slowly and should never be carried above 2.5 volts. The changing electromotive force should not exceed that of the battery more than 5 per cent. Cells should not be discharged more than two-thirds of their capacity and are never left standing uncharged.

Changes and Improvements.

By W. H. Wakeman.

Are all of the water tube boilers now in the market improvements over the common shell boiler fitted with 3 or 4 inch tubes? I am led to ask this question by noting the experience of a firm in this vicinity who formerly used the return tubular boilers mentioned, but during the course of certain changes they were removed to another place and are doing good service there.

A water tube boiler was put in to do part of the work formerly performed by the return tubulars. It is not necessary to state the particular kind of boiler, as it is not my object to single out the product of any firm for condemnation or recommendation, but only to discuss the subject of "Changes and Improvements" in a general way. This boiler is not considered an experiment, as many of them have been sold to various parties.

The return tubular boilers very seldom needed repairs of any kind, but the brick furnaces required attention occasionally. The water tube boiler with its small tubes and numerous joints is a constant source of annoyance and expense. It is perfectly safe to say that a dozen of these tubes have failed during the past few months, and every time that one of them gives out it is necessary to haul the fire, let out the water, and put in a new one.

Every effort has been made to discover the cause of failure, but without success. The manufacturers cannot locate the real cause, consequently nothing can be done to provide a remedy. When a tube fails they shut down and put in another, taken from a stock of them that they keep on hand. This is quite a change from the old tubular boilers that required practically no repairs for perhaps ten years, but the improvement made is surely a minus quantity.

The brick furnace of this boiler is more expensive for repairs than any return tubular that I ever heard of. Another firm well known by the writer, is having an experience that is almost as costly. Neither one of them will put in more of this type of boilers when renewals or additions are needed.

Let us give the claims made for this kind of boiler a little attention that we may note their value. The tubes are made of very thin material, therefore heat passes through it very rapidly, but the tubes of a return tubular boiler are only about one-tenth inch thick, and it is well known that the greater portion of the heating surface is in the tubes, therefore but little advantage can be gained in this way. Certainly not enough in a whole year to pay for one shut down.

As this boiler holds but little water, it is claimed that steam can be made very rapidly, and this is undoubtedly true, as 80 pounds pressure can be raised in about 15 minutes. Some men seem to lose sight of the fact that because pressure can be raised rapidly it does not prove that steam is made at low cost of fuel during a day of 10 hours.

What is the special advantage gained by being able to raise the pressure so rapidly, in a stationary plant? I can understand the value of this featuure in the case of a fire engine, but such conditions do not apply to an ordinary stationary plant. I have five return tubular boilers, and there is about the same pressure on them in the morning that I leave at night, hence it is available for instant use, consequently I do not have to wait 15 minutes after the fires are burning briskly for a working pressure. My friend in charge of the so-called improved type of boiler finds that in about 15 minutes after his fire is banked his steam gauge pointer has fallen to zero. These facts taken from actual service show very plainly that although it takes longer to raise steam from cold water in the common return tubular boiler, it falls just as rapidly, hence there is no special advantage in it when everything is taken into consideration.

The disadvantage of it is plainly shown by the following: If the water line in this boiler is raised to the top of the gauge glass, the pump stopped and steam is used as usual, the water line will fall to the bottom of the gauge glass in three minutes. If anything happens whereby the pump must be stopped for two minutes under ordinary circumstances, the plant must be shut down. When we consider the body of water contained in an ordinary tubular boiler and the time it takes to lower it, say six inches, the difference is very plain. We have very good pumps at the present time, that can be regulated nicely, but there are few places where it is not a burden to pump in every minute, the exact amount evaporated.

This boiler is equipped with a high and low water alarm, and it is in use for about one-half of the time on an average. Can anybody blame the engineer for putting a muffler on the whistle? I do not.

In another plant one of these water tube boilers is used for power and heating purposes. When steam is first turned into the heating coils in the morning, it lowers the water level as a matter of course. With a tubular boiler there is chance for having a reserve supply on hand, for as a rule if there are three gauges of water at this time the level will not be lowered enough to reach the danger limit, before the steam that is condensed into water begins to come back and prevents it from going lower.

When we take into consideration the small amount of water contained in the water tube boiler as described in a preceding paragraph, it will be very plain that as soon as steam is turned into the pipes, fresh water must be pumped into the boiler without delay When the water begins to come back it speedily raises the water level above the safe limit, if the matter is not attended to, therefore the engineer must let it go to the sewer until the boiler can take it safely, thus causing a direct loss by wasting water that must be paid for, and an indirect loss by using water that contains scale-making impurities, and allowing the pure article to run into the sewer. Heat is also lost by the operation.

The foregoing refers to changes made in the type of boiler used, but I wish to call attention to one change which has taken place in the return tubular boiler. The first one that I ever had charge of was set with a flush front, or in other words no part of it extended beyond the furnace doors, and for several years I saw no other kind of setting. After a time I found that occasionally one was set with the shell projecting beyond the furnace doors a foot or more.

It appears as if the average fireman had enough unpleasantness to contend with when a flush boiler front is before him, but with the shell a foot nearer, it is decidedly more hot and unpleasant. When the engineer inspects the furnace and shell while they are cool, and coming out of the former attempts to straighten up before the proper time, he understands what is meant when these boilers are called "head bumpers."

What advantage is gained by this change? If it costs less to repair the front part of furnace in this case, the job must be done more frequently, therefore no saving is made.

It is claimed that there is less liability of burning the dry sheet on a half arch, or projecting front, and while this is true, there is no excuse for allowing the brickwork to fall down and leave this part exposed. Twenty-five years' experience along this line gives me the right to speak with confidence in the matter.

A few remarks concerning what are sometimes called improved plans for operating boilers will be appropriate in this connection. One of the plants above referred to was formerly supplied with steam by horizontal boilers that were not forced to an unreasonable extent. While a respectable rate of combustion was maintained, the gases escaping to the chimney were at a comparatively low temperature, which I am not able to state definitely, neither can I tell just how hot they are now, as they come from the water tube boilers, but when the reader knows that the stack is frequently red hot for several feet above the roof, it is plain that much heat is going to waste.

Can this change be considered an improvement? I think not. Repairs are now expensive and frequently required, work for firemen is so hard that but few will accept the position, and fewer still keep it for a respectable length of time, although an extra high price is paid on account of the existing conditions.

While there are none too many boilers in this plant the manager is constantly seeking for some plan that will enable him to secure more rapid combustion, so that he can lay off one boiler. Perhaps he wishes to have the stacks red throughout their entire length, but the reason for this is not plain, as it will not increase their usefulness, and they will never be ornamental. If another boiler should be added to this plant and all of them used every day, the cost of fuel would be less, and the boilers prove more durable.

A Modern Steam Generating Plant in Scotland.

By Frank T. Perkins.

At the Pinkston Generating Station where current is supplied for operating the Glasgow Corporation Tramways, a steam power plant has been installed which generates steam for four vertical compound engines each having a maximum capacity of 5000 H. P., also two auxiliary engines of 1000 H. P. each. The boiler room of this plant is shown on the cover of this issue and is 244 feet long and 84 feet wide, the height from the floor level being 70 feet. The two chimney stacks noted in Fig. 1 are 263 feet high and have an internal diameter of 16 feet. The chimneys are built of brick with ornamental stone and terra-cotta mouldings, and the pedestals are octagonal in shape, carried to a height of 103 feet, above which point the chimneys are circular. The width across the base of each chimney is 50 feet.

There are 16 water tube boilers in the boiler house divided into eight batteries of two boilers each, four batteries on each side of the boiler house. These boilers were constructed by the Babcock and Wilcox Co., and are of the horizontal water tube type each having a capacity of 20,000 pounds of steam per hour at a pressure of 160 pounds per square inch. Each boiler is provided with straight tubes, 4 inches in diameter and 18 feet long and has a total heating surface of 5137 square feet. The fire grate is nearly 11 feet wide between the furnace walls. Each boiler is equipped with a superheater, bye-pass, cut-out and regulating valves and pipes. A mechanical stoker of the chain grate type is fitted to each of the 16 boilers, also smokeless furnaces are used while four electric motors and driving gear have been installed for operating the stokers. The motors are placed in the basement of the boiler house, one at each end of each shaft, and the two driving shafts run the whole length of the boiler batteries one on each side, under the floor, so that each shaft can, in case of emergency, be driven from either end. The two main driving shafts are four inches in diameter made of forged steel while the driving mechanism is so arranged that the speed does not exceed twenty-five revolutions per minute. The electric motors drive the shafts through double reduction spur gears enclosed in dust proof boxes.

The water for the boilers is supplied from the Glasgow Corporation water mains through two storage tanks placed on girders between the two chimneys. Each have a capacity of 18,000 gallons and measure 10 feet deep, 12 feet wide and 25 feet long. Two fuel economizers are installed, each capable of handling 2000 gallons of water per hour, raising its temperature from 90 to 160 degrees Fahr. A seven inch steam pipe is connected from each battery of boilers into a nine inch cross main leading into the main header which is 16 inches in diameter arranged in two parts connected by two expansion bands. This system of piping was devised in order to supply the steam in the shortest and most direct way from the boilers to the engines. Two of the 5000 H. P. engines are equipped with pipes 14 inches in diameter from the header while the other two engines of the same capacity are supplied with steam by two 15 inch pipes from the header. As there is only one row of engines in the entire room and the length of pipe is short, the steam mains are placed overhead and are constructed of lap-welded steel.

Fig. 1. Pinkston Generating Station, Glasgow, Scotland.

A steel flue is carried on the steel girders over each row of boilers. The two main flues are connected to the boilers by steel uptakes. They are branched off to the economizers about the middle of each main flue and the two branches of each flue enter the chimney outside of the boiler-room. Four soot doors, constructed of ⅜-inch steel plates, are provided for each main flue, the openings being 21 inches high and 18 inches wide.

Two of the vertical inverted compound condensing three-cylinder engines, with Corliss valve gear, were constructed in America by the E. P. Alliss Co., while the other two were built in England. They operate at a normal speed of 75 revolutions per minute and each engine has a five foot stroke, the low pressure cylinder measuring 5 feet in diameter and the high pressure cylinder 3½ feet in diameter.

Fig. 2 represents one of the 5000 H. P. Allis engines before shipment to England.

The engines are directly coupled to four generators each, having a capacity of 2500 kilowatts. These alternators

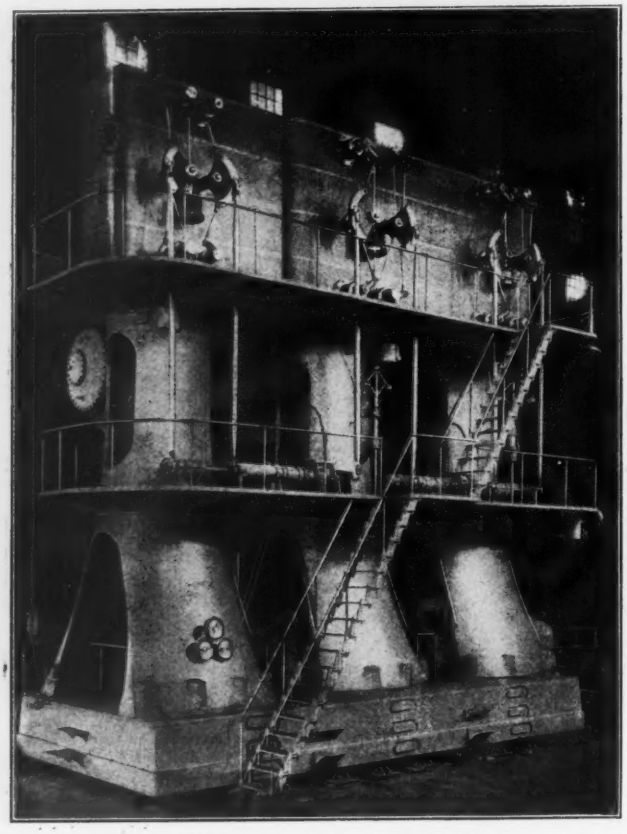


Fig. 2. One of the 5000 H.P. Allis Engines installed at Glasgow, Scotland.

supply a three-phase current of a frequency of 25 cycles per second and a pressure of 6500 volts. These machines have revolving fields with forty poles each and stationary armatures.

The generators weigh complete about ninety tons, the revolving field weighing 38 tons and supplying the necessary fly wheel effect while the armature and frame weigh 44 tons. The armature frame is 21½ feet in diameter while the revolving field frame measures 16 feet 8 inches in diameter.

The steam generating equipment of this plant as well as the coal conveying apparatus and auxiliary machinery, including the feed-water pumps, condensers and air pumps are of the latest and most modern design, the latter being shown installed in the Auxiliary Room of this plant, Fig. 3.

The coal is fed to the boilers from overhead bunkers capable of holding about 2400 tons, these bunkers being filled by two gravity chain bucket conveyors. Each conveyor can handle 50 tons of coal per hour, and draws its supply from an outside bunker, built just outside the main building, which, in turn, is supplied from the six railway tracks, which enter on two different levels.

The motive power in each case is supplied by a powerful four-pole, continuous-current, shunt-wound dynamo. These motors are connected to a 500 volt circuit, and run at a speed of 200 r. p. m. This speed is reduced to suit the conveyor by a series of spur wheels, the last of which is connected up to the driving wheels by a common spindle.

An ingenious and original design of tilting gear is used for emptying the buckets at any point along the line. This gear, which can be fixed at any point where it is desired to unload, consists in a couple of levers with a small roller on the end of each. These rollers enter pockets in the bucket side plates, which are steadily rotated until they have emptied, after which they are released and left free to continue their course. This process takes place in a smooth and satisfactory manner without in any way interfering with the steady and continuous motion of the conveyor. The tension gear consists of two plummer blocks with a screw attachment to pull them along slides in a cast iron base. The conveyor chain passes over two cant wheels keyed to a shaft with these plummer blocks as bearings. In this way the conveyor chain is kept as taut as is found necessary for its proper working.

A new and novel method of distribution is introduced to fill the buckets while in motion. This consists in a revolving box-shaped contrivance driven by a spur wheel, which engages the moving chain, and is so designed that it is open only when the bucket is in a position to receive the coal or ash, as the case might be. This distributing box is fed by a shoot from the side.

The total length of each conveyor is about 860 feet, including a vertical lift of 107 feet. The buckets move at a speed of 45 feet per minute. The whole arrangement of the boilers, bunkers, shoots and conveyors reduces manual labor in this department to a minimum. The railway trucks containing the coal are run into position over a series of bunkers, into which they are emptied direct. The conveyor, passing underneath, is fed by allowing the coal to pass from the bunkers into the distributing box described above. The tunnel under the bunkers is about 110 feet in length and when filled the buckets pass over guide cant wheels travelling back its extreme length, passing around another couple of guide cant wheels and rising vertically through a distance of about 33 feet to ground level. The conveyor assumes a horizontal motion for some 215 feet along the bottom of the boiler-house. It then rises 74 feet to the top of the building. In traversing the 210 feet along the top of the boiler-house the buckets are emptied at various points into the coal hoppers over the boilers by means of the tilting gear already mentioned. The empty buckets descend the other side of the boiler-house back to the tunnel where they may once more be filled, and thus complete their cycle of operations.

The coal in the hoppers passes to an automatic weighing machine, and thence by a shoot on to the stokers, also automatic, of the Babcock & Wilcox boilers.

The conveyor is also used for removing the ashes from the boilers to railway trucks, to which it passes through a shoot in the boiler-house wall. The conveyor receives the ashes from specially constructed ash-pits, elevates them to a storage hopper, from which they are delivered to railway cars.

Glasgow is well supplied with water from Loch Katrine, which is equally excellent both for drinking and steaming purposes, so that no provision has had to be made for softening the water. The boilers are fed from two large storing tanks situated between the two chimneys, and which are supplied from the ordinary public water service.

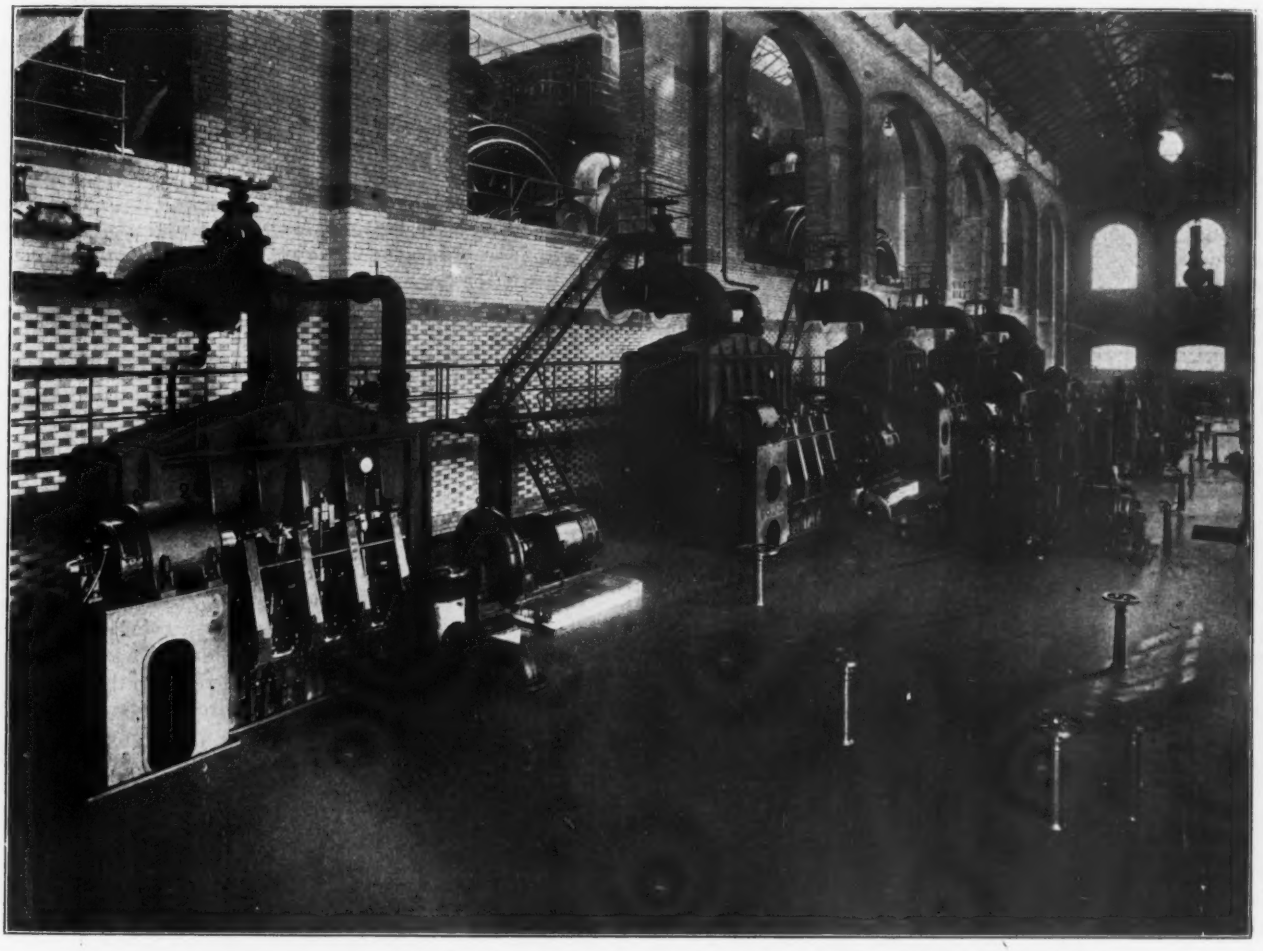


Fig. 3.—Auxiliary Room of the Pinkston Generating Station showing Condensers, Feed-water Pumps and Air Pumps.

The feed-water is forced into the boilers by five feed pumps, operated by motors, and one steam driven feed pump. The former pumps are capable of delivering 8000 gallons per hour, against a boiler pressure of 180 pounds per square inch, and the steam pump is capable of delivering 16,000 gallons of water per hour against the same pressure.

In dealing with the large quantity of exhaust steam which is inseparable from the working of a big power station, such as that at Pinkston, it is necessary not only to provide an efficient and trustworthy set of condensers, but it is also very important that floor space should be economized and utilized to the greatest advantage. The condensers now at Pinkston were designed with this object in view, and hence their neat and compact appearance. The larger one shown in Fig. 2 is capable of condensing 60,000 pounds of steam per hour, and the smaller, which is used as an auxiliary, 24,000 pounds of steam per hour. The condensers, which take up a rectangular floor space, have thick cast iron shells greatly strengthened by a network of ribs. The tube plates are of rolled brass with solid-drawn brass tubes, expanded at one end and packed with cotton wick, set up with screwed ferrules at the other. The larger condenser contains 2690 of these tubes, and the smaller, or auxiliary, 1072, and through these the circulating water passes twice.

In front of the condensers are four three-throw air pumps, which have a very high efficiency, and dispense with foot and bucket valves. Each set of pumps is run in connection with one of the large condensers, and is capable of dealing with 60,000 pounds of exhaust steam per hour. The arrangement for driving, as our illustration shows, is of the simplest description. A slow-speed electric motor, is coupled up direct to the crankshaft, and in this way all waste of power, due to transmission through a series of spur wheels, or other speed reducing devices is effectively avoided. Besides this, the above arrangement provides a neat and compact machine occupying a minimum of floor space, which is a most important factor in the design of

power stations. The pumps have 16-in. diameter buckets, with a stroke of 12 inches, and the crankshaft runs at 150 r. p. m. The electric motor is connected to a 500-volt circuit.

Besides the four larger air pumps, there is also one smaller auxiliary pump, 11 inches diameter x 10-inch stroke, of a similar design to those described above. This smaller size can deal with 24,000 pounds of exhaust steam per hour, and, like the larger size, its motor runs at a speed of 150 r. p. m.

The Economizer.

By J. J. McGuire.

The cost of steam power production is made up of numerous elements, but after all the coal pile is the point at which true economy should begin. In any analysis of boiler tests, it is easy to determine the relative amounts of heat generated which go toward evaporating water in the boiler and in the fuel, as well as the amount lost by radiation. But most noticeable of all is the percentage of heat developed that escapes, by way of the chimney, to the outside air through the medium of the hot flue gases.

This surplus heat, escaping up the chimney, should not be allowed to go to waste, but should be used for heating the feed water for the boiler. The feed water furnished to the boiler must be heated from its original temperature to the temperature of the steam before any of it is evaporated. The heat required to do this is generally expanded by the fuel that should be utilized in generating steam.

If the absolute pressure in the boiler is 100 lbs. per square inch the temperature is 328°, and if we assume the original temperature of the feed water to be 60°, there must be expended 328—60=268 heat units to raise the feed water to the temperature of the steam. At this pressure it takes 1154 units of heat to evaporate one pound of water from a feed water temperature of 60°. Therefore it requires over 23 per cent. of the fuel to raise the temperature of the feed to that of the steam.

From the above it can be easily seen that the higher the temperature of the feed water entering the boiler, the greater is the saving in the cost of fuel. But it is very important that the heat that is imparted to the feed water, before entering the boiler, should be heat that otherwise would be wasted.

There are two sources from which this heat is available and they are the exhaust steam and chimney gases. All heat imparted to the feed water by injectors comes originally from the boiler steam and is returned thereto, and consequently represents no saving whatever, so far as the total heat required is concerned. At many power plants the cost of fuel is exceptionally high owing to the cost of transportation from the mines to the plant and on this account engineers began looking around for some reliable means of reducing the coal consumption. This end is attained by the economizer and at the present time many steam plants are equipped with economizers.

The economizer makes use of the heat in the waste furnace gases to raise the temperature of the feed water. It consists of vertical pipes placed in rows about four inches apart. Each row is connected at the top and at the bottom to headers. The tubes and headers are made of cast iron, as the sulphur and gases from the furnace would attack them if they were made of wrought iron. Screwed joints should not be used, but rather pressed joints, so that there will be no leakage as the economizer is subjected to severe strains due to contraction and expansion.

Economizers are placed in brick flues, between the boiler and the chimney, and a by-pass flue must be provided to conduct the gases to the chimney when the economizer is out of service. The water enters the lower headers at the farthest point from the furnace, or where the economizer is coolest; it flows up the rows of vertical tubes, into the upper headers, then in the delivery pipe from where it is forced into the boiler. The hot gases from the furnace pass among the rows of tubes on their way to the chimney, coming in contact with the rows containing the hottest water first. The temperature of these gases is about 600°, which represents a big loss if they are allowed to escape up the chimney at such a high temperature. But by coming in contact with the tubes of the economizer their temperature is reduced to 250°, or 300°, which represents a drop of 350° or or 300°, some of the heat of the gases being utilized in raising the temperature of the feed water.

On account of the tubes being in the path of the gases they become covered with soot, which is a very poor conductor of heat, and if allowed to accumulate to any depth, on the tubes, materially lessens the efficiency of heat transmission. In order, therefore, to obtain the best results, the surface of the tubes must be kept free from soot, and for this purpose scrapers are provided, which are continuously moved slowly up and down, along the surface of the tubes, and in this manner scrape all soot from them so that a clean surface is always presented to the hot gases, thereby enabling the tubes to conduct as much heat as possible to the water contained in them. The power necessary to operate these scrapers is obtained from a small auxiliary engine, that is fitted up in the boiler room and connected to suitable gearing on top of the economizer, or wherever feasible. The power may be transmitted from a shaft which is connected in some manner with the engine room, if desired.

Some of the advantages of hot feed water are as follows:

It prolongs the life of the boiler, by preventing the usual contraction and expansion due to cold feed water, which is so injurious to boiler plates. It also reduces the amount of coal necessary to keep up the required pressure. For example, if we have a boiler carrying 100 pounds per sq. in. absolute, the original temperature of the feed water is 60°, but by installing an economizer the temperature is raised to 200° F; this represents a saving of 200—60=140 B.T.U. per pound of feed water, which means just so much heat saved that would otherwise escape up the chimney.

The total heat at a pressure of 100 lb. absolute is 1182 heat units. Therefore the heat supplied by the fuel above 32°=1182—(60—32)=1154 heat units. But after the economizer is installed, the heat required is 1182—(200—32)=1014 heat units. The gain in per cent. will then be $\frac{1154-1014}{1154}$=12⅛ per cent., which represents the gain due to the installation of the economizer and, of course, the saving in coal consumption.

It purifies the feed water because the impurities are precipitated when the temperature of the water is raised. The most troublesome scale-forming substances are the carbonates and sulphates of lime and magnesia. Carbonate of lime (which is the same thing as marble or limestone) will dissolve in water that contains carbonic acid. By heating the water, the carbonic acid is driven off, and the carbonate is precipitated in solid form. The carbonates of magnesia act in a similar manner. The sul-

phates are soluble in water at low temperature, but are completely insoluble in water at a high temperature. Thus it is evident that if the feed water is heated to a high temperature, the greater part of the scale-forming substances will be precipitated in the solid form, so that they may be blown out or scraped out through the hand or mud holes. The slow circulation of the water in the economizer gives ample time for it to get rid of a great part of these scale-forming materials.

By introducing the economizer into the chimney flue, the resistance to the passage of the gases is greatly increased, and consequently the strength of the draft will be greatly decreased; this, therefore, forms one of the disadvantages of the economizer. In order to have the strength of the draft the same as it was before the economizer was installed, we must either increase the height of the chimney, since the strength of the draft increases as the height of the chimney increases, or a forced draft system must be adopted.

By comparing the advantages and disadvantages of the economizer, it will be readily seen that the advantages far outweigh the disadvantages, and that it must therefore be a useful adjunct in connection with the working of stationary steam boilers.

THE REGULATION OF STEAM ENGINES.

Method of Speed Control. Cut-off and Throttling Engines.

PART II.

Before continuing the discussion of shaft governors, it may be well to consider the different classes into which they may be divided. In the two shaft governors previously described, the action depended upon the centrifugal forces acting on the governor weight, the system of levers being kept in equilibrium by means of the tension of springs.

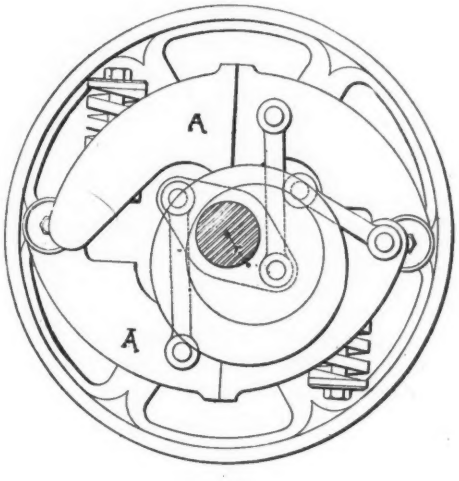


Fig. 14.

Another important type depends upon the action of inertia upon the governor weight and the third type depends upon the combination of the inertia and centrifugal types, where the speed of rotation is maintained for any given load by the centrifugal forces, the inertia being the governing factor when there is a change of load. Another classification of shaft governors depends upon the movement of the valve. In some forms of governors the lead remains constant when the load changes while in the second type, the lead either increases or decreases as the load on the engine varies. If the angle of advance only is varied with an engine having a single valve, the cut-off is changed and the lead is changed, sometimes in a manner that is not desirable. As lead is given so that the piston may feel the full pressure of the steam at the beginning of the stroke, too much lead would tend to stop the engine before it reaches the dead point, and too little would make the piston move under less than the full pressure at the beginning of the stroke and the engine would therefore do less work than it is capable of

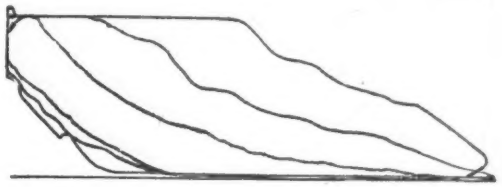


Fig. 15.

doing. If the eccentricity is changed, leaving the angle of advance unchanged, the same trouble is experienced but in the opposite direction. That is, when the angle of advance only is changed decreased cut-off means more lead. When the eccentricity only is changed, increased cut-off means more lead. A combination of these two should give a variable cut-off with constant lead and all single valve automatic engines attempt to produce this effect. Upon examining the condition which is necessary to produce constant lead, it is found that the point of suspension of the valve rod must move in a straight line. The Armington-Sims governor, illustrated in Fig. 14, represents a form of governor which uses a single valve, consequently it controls the compression, as its position is changed, to meet the requirements of varying loads. As represented in the figure, the weights AA are in a position when the engine is first started. As the speed is increased the weights, AA,

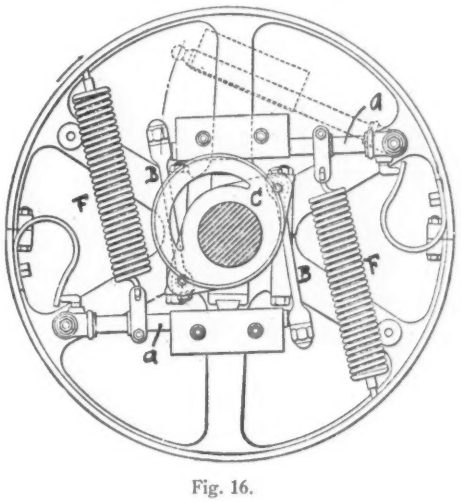


Fig. 16.

are thrown outward by the centrifugal force, the effect of which is to roll the inner eccentric in one direction and outer one the opposite direction. By this means the eccentricity, represented by r in the figure, is reduced, the travel of the valve is shortened and the angle of advance is increased. The result of decreasing the valve travel and of increasing the angular advance is to make the cut-off earlier and increase the amount of compression; in other words the work done by the steam is less. As the speed

decreases, the weights move back toward their original positions, the radius of eccentricity becomes longer, and the angle of advance decreases, consequently cut-off takes place later and the work of the steam is increased. The speed of the engine may be changed by tightening or loosening the nuts at the ends of the springs. Fig. 15 represents three cards taken from an Armington and Sims engine with three different loads.

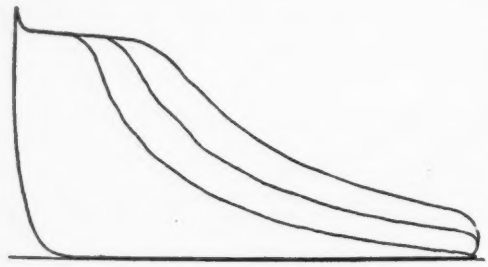


Fig. 17.

The Buckeye engine governor illustrated in Fig. 16 is one of the oldest forms of shaft governors. In this form of governor, it will be observed that it differs from those described above in this essential feature; that the angle of advance only is varied by the centrifugal action of the weights, this being all that is necessary, as in this engine two valves are used, a main or distribution valve actuated by a fixed eccentric and a cut-off valve actuated by the governor mechanism.

In the case of a single valve operated by a shaft governor, as before stated, if the angle of advance only is altered, the cut-off may be varied to suit the conditions of load, but in that case the lead will also vary in such a way that it will increase as the cut-off is decreased. If, on the other hand, the regulation is performed by varying the eccentricity alone, the reverse would take place, and hence for shaft regulation in connection with a single valve it becomes necessary to vary the eccentricity and angle of advance simultaneously. This is not the case where a separate distribution and expansion valve are used as in the Buckeye engine, because the admission and exhaust closure are affected by the distribution valve, and the governor acts only on the cut-off.

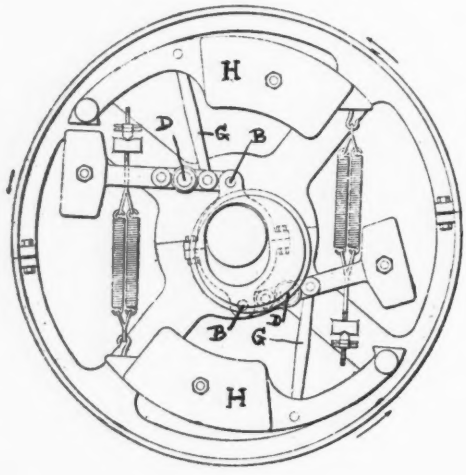


Fig. 18

Referring to the above cut, it will be sen that the governor consists of two weighted arms, *a a*, pivoted at one end to the wheel and connected at the other to the ears of a loose eccentric C, by means of links, BB. The tendency of the arms to move outward by virtue of their centrifugal force is resisted by the action of the spiral springs, FF. As the speed increases, the centrifugal force of the weights partially overcomes the pull of the springs, and the eccentric is shifted or advanced and thus the cut-off made to take place earlier. Fig. 17 represents three cards taken from a Buckeye engine with three different loads.

The Fitchburg governor is illustrated in Fig. 18. This form of engine uses independent steam and exhaust valves. The upper valves are worked by means of a cam wrist plate and controls the points of admission and cut-off, the latter being regulated by the governor. The lower valves control the points of exhaust release and closure. The action of the governor is as follows:

So long as the engine is below speed the eccentric is kept in the longest throw by the tension of the springs and steam follows about three-fourths of the stroke, but as soon as proper speed is reached centrifugal action causes the weights H to overcome the tension of the springs and to move outward at the same time lengthening the springs. By means of the connecting rods GG the outward motion of the weights turns the suspension arms C upon their fulcra D, and through the ears B, the eccentric is carried across the shaft, and as the arcs described by the centers BB are in opposite curves they compensate each other and the centre S of eccentric follows a straight line in its movement, preserving a constant lead opening. This decreases the eccentricity, and increases the advance of the eccentric, giving an earlier cut-off to the valve until, when the eccentric is swung squarely back of the crank, the valve opens only the lead, there being all points between this and extreme cut-off for variation.

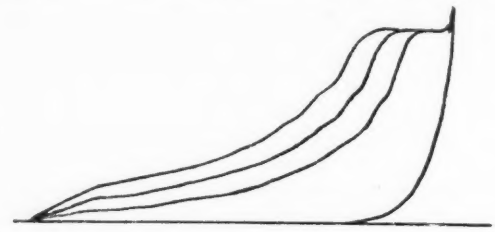


Fig. 19.

This governor can be used with a single valve, changing the point of compression at the same time that it changes the point of cut-off or can be used to actuate an admission valve only, the exhaust valve being driven from a second eccentric and remaining constant as to all its duties, Fig. 19 represents three diagrams taken with different loads from a Fitchburg engine.

Liquid Fuel.

From a number of tests that have been made, the results of the best installations with boilers of known efficiency show 15 lbs. of water evaporated from and at 212° Fahr. per pound of oil fuel used. Any advance upon this with the spray method of firing is generally considered impossible without further refinements in boiler fittings and a far more careful use of the same than is commonly found.

Some Engineering Experiences.

By a Consulting Engineer.

Along in the early eighties I entered the office of a certain machine shop, builders of, at that time, a well known line of stationary engines. The proprietors, one an elderly man and the other a younger but less experienced man in the practical workings of a steam plant. Upon presenting my card I was met with "No, we have only a small boiler and it won't pay us to make any change to it." "Yes, certainly you can look around if you want to but I expect you won't find things much worse or better than most boiler and engine rooms around here." Thinking there was little or no use proposing alterations here I went out into the shop, accompanied by both proprietors. They were transmitting to the line shaft upwards of 150 H. P. and exhausting into the atmosphere. The boiler feed water was pumped cold from a well directly into the boiler. I proposed to sell them a feed water heater, gave the usual reasons why it would be advantageous to the purchaser, only to be met with "No sonny, if we were to use a machine like you are advocating we would create a back pressure and our engine now has all she can do, in fact she is already overloaded so much that she cuts-off so late she don't expand down to near the atmospheric pressure." I talked some more and left thoroughly discouraged. A few weeks later the younger partner came into my office and said: "My partner, Mr. F., is going away for a few days. I was rather impressed with what you said when you were at our shop recently. Can you get one of those heaters to our place and have it working before he gets back?" What happened? Well I expect it will be best to repeat what the engineer told me. It seems that about a week after the heater was installed, the old gentleman walked into the engine room and seeing the heater, said, Tom, what is this? A heater sir, says I. A heater, says he, and ain't it warm enough in here without a heater? says he. Yes, sir, says I, but it ain't to make the boiler room warmer, it's to heat the water before it goes into the boiler by using the exhaust steam. And does it take the chill off of the water? says he. Well you can try it for yourself, says I, and taking a bucket I opened the valve and let the water run out of the heater into the bucket. When the bucket was nearly full I said now sir you can try it, and believe me or not, he jabbed his left hand down into it and scalded it until the skin peeled off, and all he said was, Tom, if we'd had one of them heaters in years ago we would have been rich by now."

About three months ago I found a plant where the only means provided for regulating the draft was a damper in the stack, so placed that the fireman had to climb on top of the boiler to open or close it. Did he do it? No, he preferred to regulate the draft by opening and closing ash-pit and firing. The owner was not willing to spend a cent in actual cash, but gave me permission to use some grooved pulleys and rope I found about the place, and also the help of a carpenter. Between the two of us we rigged up the pulleys and rope so that the fireman could open or close the damper with less trouble than he could operate the fire or ash-pit doors. The result was they saved two tons of coal per week. The boiler room is now fitted up with modern steam appliances, including an automatic damper regulator in a polished wood case and glass front.

The above reminds me of a damper regulator installed and left in good working order. Shortly after, complaint was made that it was not working right, sometimes it would work and at other times the damper had to be worked by hand. After looking round and finding everything in good repair, I shut off steam, took out a little plug, squirted in a lot of kerosene, put in the plug, turned on the steam, and so far as I know, the damper still is doing good work.

Heating of Crank Pins.

The crank has ever been one of the most troublesome parts of the steam engine. It must be of such a size that it not only must have strength enough to sustain the entire pressure of the piston, but its diameter and length must be sufficiently large to prevent heating. The most usual way that a crank pin fails to perform its duty, is by becoming overheated, the strength being generally sufficient, when designed large enough, to prevent overheating. The diameter does not enter into the consideration of the friction on a crank pin, because, while the diameter reduces the pressure per square inch, the larger the diameter of a crank pin is made, the greater is the speed of rubbing between the pin and its boxes for a given number of revolutions.

Within reasonable limits, it is generally stated that the longer a bearing is, the cooler it will work. The crank pin must withstand the pressure on the piston, which pressure is concentrated at the crank pin; so that if the pressure on the piston is 100 pounds per square inch, the pressure on the crank pin may vary from 500 to 2000 pounds per square inch, as usually found in practice. The tendency of this pressure is to force the film of the oil out between the crank and its boxes, and for this reason oils are more easily expelled from small than from large journals.

If oils are expelled by extreme pressure, the friction increases rapidly and the surfaces begin to heat and wear immediately, and sometimes it increases so fast that the pin will soon smoke within a few revolutions after the metals of the crank pin and the boxes touch each other. The supposed superiority of brass or Babbit metal-lined boxes lies in their great softness and conductivity for heat. Brass will conduct heat away from two to four times as rapidly as iron. However, the film of oil interposed may render this conductively of less avail than is generally supposed, and the advantage lies in the fact that being a softer metal, it receives the principal damage and can be more easily repaired than the crank pin, which is usually made of high carbon steel. Phosphor bronze, is in general use, when the wear is very great.

A great increase of the velocity of the rubbing surfaces renders the bearing more liable to heat than a great increase in pressure, although the total amount of work done by friction is the same in both cases and is probably accounted for by the rapid expulsion of the lubricant. In all machines there is a limit below which the speed and pressure cannot be reduced, and therefore the journals should be so proportioned that no more heat due to friction must be generated than can be carried away by the oil, the atmosphere and the conductivity of the metals.

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Zinc, Scale and Corrosion.

It seems to be a generally accepted statement that the suspension of zinc plates in the water in a steam boiler has the effect of keeping the boiler surfaces in good condition. That this is true in a large number of cases cannot be doubted, since the use of zinc slabs in marine boilers is very common and widespread. However, its purpose is to prevent corrosion of the internal surfaces. Sea water, while strongly impregnated with salts, may, and frequently does, contain corrosives, and in order to prevent the gradual demolition of the plates, the zinc plates are introduced.

The action is purely a chemical one. Most metals are quite easily attacked and eaten away by ordinary acids, but there are some which are much more easily corroded than others. Thus it is that zinc is more readily subject to corrosive actions than iron. Consequently, when zinc slabs are placed in water containing corrosive impurities, it is eaten away at a rate depending upon the strength of the corrosive solution. In the steam boiler, the zinc is more easily attacked than the boiler shell, and consequently the former is destroyed while the latter is preserved intact.

But, as stated in the opening paragraph, it has been generally believed that zinc may be used effectively as a preventive of incrustation, also. Whether or not this is true is a much discussed question; yet it would seem very doubtful whether this property could be logically attributed to the zinc, in view of the facts as they exist.

Boiler scale is formed from sulphates and carbonates of lime and magnesia, in most cases. These substances are brought in by the feedwater, in solution. Upon heating the water to about 300 degrees Fahrenheit these impurities are no longer soluble, and are therefore precipitated in the form of a visible sediment. This, falling to the bottom of the boiler, and being carried to other parts by the circulation, adheres to the surfaces, where the heat bakes it into a hard, scaly layer.

Now, it is rather hard to see how the mere suspension of zinc slabs in a boiler is going to prevent this formation of scale. The water contains these scale-forming impurities. When it is heated, they are thrown down. The question still remains, then, as to just how the zinc is going to prevent this sludge from adhering to the plates which it must unavoidably touch.

The action of the zinc is supposed to be of a galvanic nature. As is well known, a common battery is formed by suspending a bar of zinc and a bar of carbon side by side in a solution of sulpuhuric acid. The solution acts chemically upon the zinc, and it is destroyed, being changed to zinc sulphate, while the hydrogen liberated escapes to the atmosphere. In the steam boiler, where zinc is used, the iron plate takes the place of the carbon, and the water takes the place of the acid solution. The same galvanic action occurs, with the same results.

It has been suggested, therefore, that inasmuch as these hydrogen bubbles are set free from the surface of the plate or shell, they would in that way prevent the scale-forming materials from adhering firmly. While the argument has a certain force of reason behind it, yet it must be evident that the zinc can in no way get the sludge out of the boiler, and that unless the boiler be properly blown down and cleaned at regular intervals, the deposits will become of sufficient volume and weight to pass down upon the shell and bake there in spite of all the zinc slabs that could be hung inside the boiler. The natural conclusion, therefore, would be that while zinc may be very beneficial in preventing corrosion, it cannot be successfully used as a scale preventive.

The Power in a Pound of Coal.

A pound of what is called average coal contains about 10,000 heat units and in size is somewhat smaller than a man's fist. One heat unit is equivalent to 778 foot pounds of energy, so that one pound of coal contains a latent power of 7,780,000 foot pounds. The horse-power is equivalent to the expenditure of 33,000 foot pounds in one minute, so that if this pound of coal was all burnt up in one minute, it would give out, if expended in mechanical work, the enormous sum of 235 horse-power, or 176 kilowatts. If there was no loss in the transmission of this power, it would give out in light an equivalent of

50,000 candle power, or would light 3125 sixteen candle power incandescent lights for one minute.

This is very far from the amount of energy actually obtained in practice from the burning of one pound of coal. Of the 10,000 heat units that are liberated in the fire box of a boiler from one pound of coal only about 7,000 are transferred to the water in the boiler, the other 3,000 heat units being lost to the atmosphere, from radiation and heat in flue gases, the latter being about 20 per cent. of the heating value of the coal. These 7,000 heat units are then available for use in the cylinder of the steam engine.

There have been from time to time statements made as to remarkable efficiency of a reciprocating engine, but the average of a number of tests shows that the efficiency of a triple expansion engine with high steam pressure condensing to about 28 inches vacuum will give an efficiency of only 17.5 per cent. and for the high speed non-condensing engine, an efficiency of 8.5 per cent. is fairly good. It is no doubt probable that a majority of engines run at lower efficiency than this, as tests have frequently been made which show that an engine running satisfactorily has only an efficiency of from 2 to 3 per cent. If, however, for the sake of comparison, the non-condensing engine has an efficiency of 8.5 per cent. this leaves only 595 heat units actually used by the engine out of the 10,000 heat units available, or a plant efficiency of only 5.95 per cent. This percentage is further reduced when this power is transformed into electrical energy, the efficiency of a good generator being about .92 per cent., so that this reduces the total efficiency of the plant from the coal pile to the switchboard at 5.5 per cent., and instead of lighting the 3125 sixteen candle power incandescent lamps, the actual number of lamps that one pound of coal can light for one minute, under the present system of transmission of heat into power, is only 172.

It is for this reason that scores of inventors are bending their energies to produce the electric current direct from the coal pile, and if this were possible, which does appear as yet to be near solution, it would save the heat losses in the boiler, the steam engine and the electric generator. The boiler and the electric generator are fairly efficient, the main loss occurring in the steam engine. As this loss is inherent, the refinements of using higher pressure, more expansions, superheating, steam jacketing and increasing vacuum go only to making a very large loss a trifle smaller.

A Water Tube Boiler Explosion.

In another column of this issue will be found a description of a water tube boiler explosion which occurred at the Geyer Avenue power house in St. Louis. There were twenty-three boilers in this plant, arranged in batteries. Seven Heine boilers were arranged in one battery and in the other battery were ten Heine boilers, four Babcox and Wilcox and two boilers of a local make. It was the battery of seven Heine boilers that exploded. They were of the usual water tube type, 19 feet long, with two main drums 30 inches in diameter and a steam drum 30 inches by 7 feet above the main drums. The exploded boilers were rated at 250 horse-power each and contained 113 3½ inch tubes 16 feet in length.

Since the time of the explosion several investigations have been carried on to determine the cause and place the responsibility of the accident, and the testimony is anything but flattering to the trolley company or the engineer in charge.

The opinion of the examining board is, that the stoppage in the connections to the water glass and in the feed connections, together with the fact that the boilers were continually overloaded between the hours of 5 and 7 to such an extent that the water would at times entirely disappear from the gauge glass. This caused low water in the boilers, resulting in overheating of the tubes with consequent weakening and final rupture.

While it is no doubt true that the boilers were badly mismanaged, excessive pressure was used and low water was probably frequent, it does not necessarily follow that an explosion of this magnitude should result. In fact, water tube boilers have been used this way before and are still being used, and to the credit of this type of boiler let it be said that this is the first serious explosion of the kind that has happened with this type of boiler. The safety of a water tube boiler lies in the fact that usually some small part will rupture, giving notice that something is wrong, and the chances of its being weakened throughout and giving way suddenly is exceedingly remote.

A part of the testimony that was given before the board of engineers does not seem to have gained the attention that it should have. It appears that the boilers were all connected to a header which had been in use but a few days and two of the steam fitters that put it up were still working on it. One of these men was killed and the other injured. Could not these men with the added strain they imposed upon the pipe line with their wrenches have been sufficient to cause the main to break? And if the main did break first, what would happen? The pressure being relieved, the steam carrying the water with it would move with enormous velocity from the broken joint. This would relieve the pressure within the boiler and cause what water was left to become evaporated and the resultant steam to become superheated. This enormously rapid expansion from water under pressure to steam at atmospheric would give a hammer blow which no boiler could resist, and hence the boiler would give away at the part of boiler that had to withstand that shock. This seemed to have been at the back end, at the water leg. If this caused the first boiler to explode, the others would almost simultaneously follow from the same cause. At any rate, it would be interesting to know why the water tubes did not burst, as usually occurs in explosions of water tube boilers, but why the water legs were stripped off of the ends of the tubes, leaving the latter free. It seems as if a sudden release of pressure causing an excessive shock to the water leg is the most plausible explanation, rather than that of low water.

Peculiar Explosion of Water-Tube Boilers.

By John C. Higdon, M. E.

There occurred in St. Louis, on December 21st last, a most singular and destructive explosion of water-tube boilers. That a genuine explosion took place, is evidenced by the photographs taken by the writer on the morning after the explosion, which occurred at about 5 o'clock P. M.

The force of the explosion was exerted in all directions and brick and iron were scattered about for a radius of three squares. Two boilers were hurled east into Missouri Avenue, three others went south into the car sheds and part of others were thrown northward through the building. A boiler shell was carried over a row of houses to a vacant lot two blocks away and a steam drum landed in Allen Avenue, having been hurled over the car house. A general alarm of fire was turned in but there was nothing for the fireman to do. Daylight showed the interior of the power house to be a mass of twisted steel, splintered timbers, bricks and mortar. The flywheels of the big engines were the only things that were recognizable as having retained a semblance of their former shape.

The views Nos. 1, 2, 3, 4 and 5 show the enormous force

View No. 1.

View No. 2.

exerted by the explosion, the same having spread apart the water-legs and pulled out the ends of nearly all the tubes, and the latter were thrown like tooth-picks all over the place. View No. 1 shows the location of the boiler-room swept completely clean. View No. 4 shows several shells leaning against cars, where they were thrown and lodged fully 100 feet from their places, the water--legs being torn off at one or both ends of the shells. In one instance (View 5) a water-leg weighing over a ton was thrown and lodged on top of a car standing in the car-sheds over 100 feet away. View 2 shows the rear end of one shell with its water-leg attached. The small pipe is the blow-off pipe, not the feed-water pipe, the latter having been attached to the front end of the shell. View 3 exhibits the back ends of a pair of the shells, the force having been so enormous as to have sheared and torn out rivets.

The exploded boilers were quite old and had been subjected to over 12 years continuous hard usage in the plant of the St. Louis Transit Co., having been erected in 1891 by the Heine Safety Boiler Co. Seven boilers exploded, the same having been located at one end of a battery of twenty-three, all connected to a single steam-header. Seven men were killed, most of whom were colored firemen. Property to the amount of $50,000 was also destroyed. There were fortunately very few persons employed at the plant, or the loss of life would have been much greater. Th Coroner's Jury held as follows: "Either the boilers and apparatus connected therewith were not in good condition, or there was incompetency or negligence in running the plant."

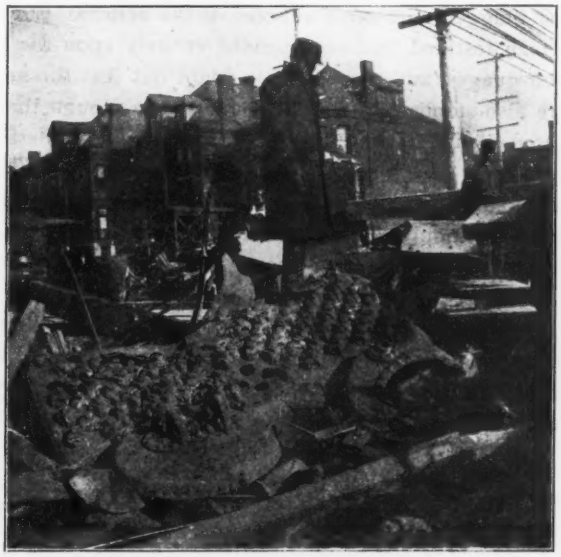
No inspection had been made by the St. Louis Boiler Inspector since February, 1903, almost a year ago, and so no blame could be laid at his door, as the law requires inspection but once a year. But it seems there had been a recent inspection by one of the Casualty Companies, and the Transit Company's chief engineer who was on duty at the time the explosion occurred testified, when asked what kind of an inspection had been made a short time before, that he and the inspector "walked up and down the boiler-room and he looked at the water-column which shows the level of water in the boilers."

Needless to say that if such action constituted an "inspection," there might as well not be any made in the future, because all real, live engineers know that the water-column connections frequently become stopped with mud and scale and render the glass-gage and try-cocks unreliable, even though plenty of water be shown there. Undoubtedly there is much room for reform in boiler inspections, and as the feed-water pipes were found to be plugged with scale on the exploded boilers, we suggest that inspections hereafter, particularly on water-tube boilers, include taking down the feed-pipes. Fig. 9 represents a sketch of the two feed-water nipples of one of the boilers. One was found entirely plugged up with hard scale, so that not a drop of water could enter, and the other had but ⅛-inch passage, utterly inadequate to supply so large a boiler, the same being

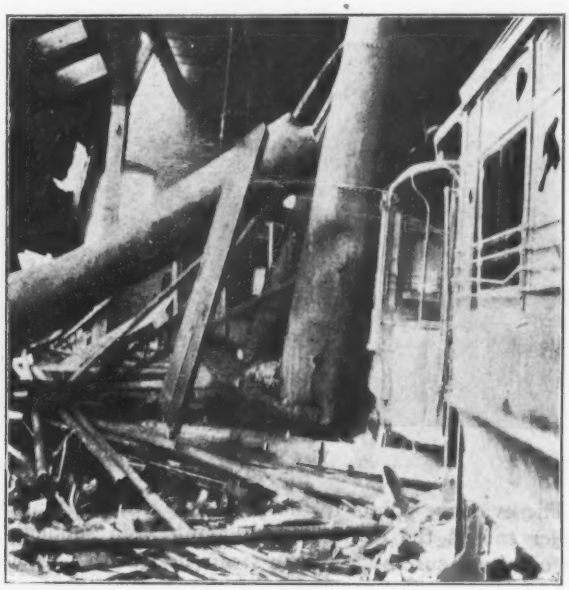
rated at 250 H. P. There were no fusible plugs in the boilers.

This would seem to have been a clear case of low water, in at least one of the boilers, as the feed-pipes were badly plugged with scale, and the engineer testified, that he depended entirely upon the glass water-gauge to indicate the amount of water in the boiler. He also testified that just before the explosions, one of the boilers had been cleaned and supposedly filled with water, and fired up; and the probability is that the tubes were only partially filled with water owing to the plugged feed-pipes, and when fire was applied, the steam accumulated to an enormous pressure, as the header-valve was also perhaps closed; and there is good evidence that a number of the safety-valves were so badly "stuck" with scale and corrosion that they could not possibly have opened at anything under 500 pounds to the square inch. There was also evidence that a new header had just been finished and connected to the boilers, so that it is very likely that the main steam-valve was closed, cutting off the seven exploded boilers from the balance of the battery.

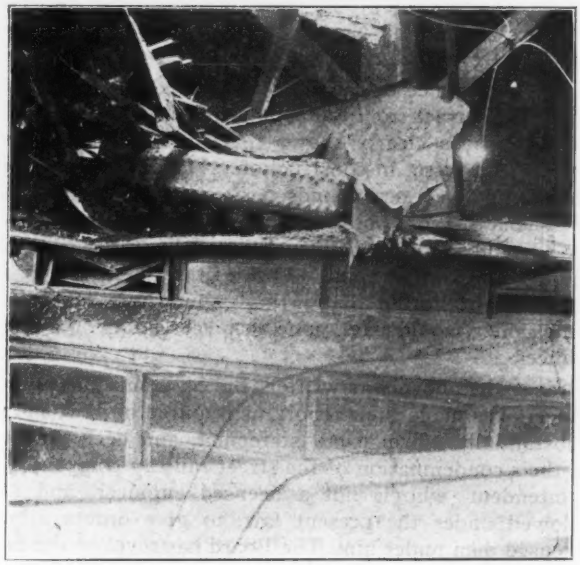
It is well known that water contained in a boiler under pressure will, when suddenly relieved of pressure, exert an energy per cubic foot equal to that exerted by one pound of black gun powder. A reasonable explanation of such action lies in the fact that the water in a boiler has an enormous amount of heat stored within it; or, in other words, the water acts as a reservoir or store-house for the latent heat. Even supposing that boiler to have contained only a bowl of water, the same would generate a sufficient energy to tear any boiler to pieces when subjected to overpressure and low water. Many have wondered why the



View No. 3.



View No. 4.



View No. 5.

View No. 6.

tubes alone did not burst, as usually occurs in explosions in water-tube boilers. In the present case, the tubes did not burst, but the water-legs were stripped off of the ends of the tubes, leaving the latter free.

View No. 17.

The evidence points to the probability that but a single boiler caused the explosion, it having been suddenly relieved of pressure by a broken steam-header, or perhaps by the giving away of a number of over-heated tubes during low water, with the safety-valve out of order and the header-valve closed, and this would be sufficient to break

View No. 18.

the header, and thereby release the steam contained in the remaining six boilers, which would have the effect of causing the super-heated water contained in them to at once flash into a great volume of steam, which no boiler could possibly withstand.

It was stated by some of the witnesses that the boilers exploded one at a time, and that seven consecutive explosions were heard. Negro firemen were employed and some worked harder than others, with the result that some of the boilers would be kept hotter than the others. The cooler boilers would thus receive most of the feed-water from the pumps, while in the hot boilers the water would get dangerously low. This was especially true during the evening hours when the load was heaviest. This is in accord with other testimony that the feed-pipes were almost plugged with scale in some of the boilers. Engineer Forman testified that he depended entirely upon the glass water-guages, and there is little doubt but that the guages were also stopped up with scale, so that although they indicated plenty of water, yet the water in the boilers was quite low. The former chief engineer, testified that several months previously they had difficulty in maintaining the proper supply of water in the boilers, owing to the overload. View No. 6 shows one of the tubes which had evidently been badly over-heated and could only have been caused by low water. Views Nos. 7 and 8 show the same tube at the top of a large pile of tubes. The ends of these tubes bear clear evidence that they were stripped from the holes in the water-legs.

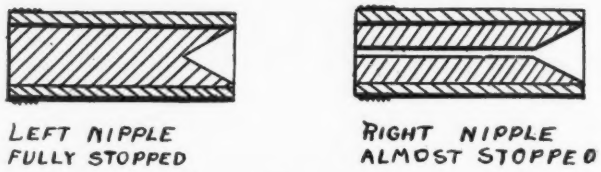


Fig. 9.

The occurrence of the above described explosion should not at all detract from the popularity of water-tube boilers, as it has been clearly shown that the explosion occurred through no defect in construction. It would have required something like 1,000 pounds per square inch to have torn the shells of these boilers in the manner indicated in view No. 2, and at other points observed by the writer while taking the photographs. The writer, therefore, has no hesitancy in stating that in his opinion any other water-tube boiler would have gone to pieces under like circumstances.

Since the above was written, the St. Louis Board of Engineers has made their report, as required by law, and they substantially affirm every statement, and even go farther in their condemnation of the street railway company's superintendent, who is not a licensed engineer, and yet is allowed under the present law, to give orders to many licensed men under him. The Board has revoked the license of the engineer who was on duty at the time of the explosion, on the ground of negligence or incompetency. The Board report in part, as follows: "A test of the safety-valves showed they required from 142 to 170 pounds to the square inch to force them open, when the law allowed them but 125 pounds. There has never been a boiler devised which cannot be exploded by an incompetent or careless engineer. A water-tube boiler in the hands of such an engineer is no safer than a fire-tube boiler."

LETTERS FROM ENGINEERS

IN ORDER to make this department of THE PRACTICAL ENGINEER as interesting as possible, a moderate rate will be paid by us for all contributions published under this heading. However, we do not assume responsibility for the ideas or opinions expressed. None need hesitate to contribute because of inability to draw or write well. We will redraw or revise whenever necessary—it is the idea we want. New ways of doing old things, criticisms of accepted theories, and general engine-room experiences are especially solicited.

Steam Pump Economy.

EDITOR THE PRACTICAL ENGINEER:

With reference to the article which appears in the editorial columns of your issue of January, 1904, under the caption "Steam Pump Economy," it occurs to me to direct your attention to an explanation of why it pays in a great many plants, in fact the majority of the large ones, to emply independent, direct-acting, steam driven pumps, as the writer of that article must have overlooked this very important reason.

No matter how wasteful of steam a pump or an engine may be, that pump or engine will be far more economical—first cost, cost of maintenance, or cost of operation considered—than will any form of condensing pump or engine so long as the exhausts can be utilized for heating the boiler feed supply, for heating water for commercial purposes, or for use in drying systems or for heating buildings.

The actual power required in either case is represented by the same heat values. There may be somewhat greater losses of heat in the case of one engine than the other, but these losses do not make up the tremendous wastage or dissipation of heat that is necessary in order to run an engine condensing, for with the best engines something like 85 per cent. of all the heat that was originally put into the steam must be thrown away through the condensing water in order to produce the same amount of power for a smaller steam consumption than can be obtained with a non-condensing engine. Whereas, in the case of the wasteful steam-eating, direct-acting, steam pump or plain slide valve engine practically all of the heat not used in producing power or lost by radiation is transmitted into the water used for boiler feed purposes and returned to the boilers, and it is therefore not wasted but utilized.

With one pound of exhaust steam at atmospheric pressure, about six pounds of water can be raised from say 50° up to 212° F., and it can be very readily proven that for every 10° added to the temperature of the feed water up to say 212° at least 1 per cent. of the entire fuel bill can be saved. In fact, it has been shown by hundreds of locomotive boiler tests that the average saving is 1.2 per cent. for every 10° adde to the temperature of the feed supply.

The value of the exhaust from the auxiliaries in condensing plants is therefore exceptionally great. To obtain the highest economic results these plants should be so designed, wherever possible, that everything should be run non-condensing until sufficient exhaust steam at atmospheris pressure is provided for accomplishing the heating of the feed supply: the balance of the plant should be run condensing. In other words, the auxiliaries should not be either direct or motor driven until the heating of the boiler feed supply is provided for.

We recall one case of a plant of about 20,000 H. P. where everything, including the boiler feed pumps, was run condensing—cutting out enough of the auxiliaries and running them non-condensing to heat the boiler feed water meant a saving of over 8 per cent. of the entire fuel bill.

One of the particular advantages of the open heaters over any form of closed or pressure heaters for condensing plants, is that, because they save the exhaust condensed in accomplishing the heating, they will heat more water to a given temperature, or they will heat a given quantity of water to a higher temperature, than will the closed heaters, thereby giving the best possible results from a limited quantity of exhaust steam.

JOHN C. JONES.

Harrison Safety Boiler Works.
Philadelphia, Pa.

Boiler Feed Pump Repairs.

EDITOR THE PRACTICAL ENGINEER:

I was called out to a nearby village the other day to look at a boiler and see "if it was worth while to fix it up or put in a new one," as the owner put it. Well, we were soon at the place and when I got into the boiler room I asked the engineer if the boiler was opened, and he showed me the plates were all out. The cold was intense—the thermometer registered 5° and 6° F below zero. I carefully but hastily examined the boiler, and pronounced it unfit for further use, and recommended a new one as soon as possible. The boiler showed some bagging, and was badly pitted over the grates, the back head leaked through fire cracked seams generally, and the boiler was in bad shape. I told them to reduce the pressure from 70 pounds to 60 pounds until a new boiler could be put in.

After the examination was over, the engineer proceeded to fill the boiler from a tank in an upper story of the building. This tank had been filled for the occasion, or rather it was in reserve in case of fire. The pipe leading down from the tank was 2 inches in diameter, and when the engineer tried to open the valve it was frozen fast, as he put it. He got a torch and after burning quite a bit of oil we succeeded in getting the valve open, and after some more delay the boiler was filled to two guages. After an hour or more, steam was raised on the boiler to 50 pounds. While I was eating my supper in the proprietor's house near the mill, the engineer came to the door and reported the feed pump broken. There was something wrong with it he said, it won't go, and it just blows steam out all around it. I went back to the boiler room and sure enough the pump was blowing the steam all around, when the steam valve was opened. I examined the steam end carefully and came to the conclusion that the frost had had a hand in it, for the steam chest was cracked across one side, from the cover to the cylinder face. The steam chest was cast separate from the cylinder, and it looked as if there would have to be a new casting before the pump could be used: but after looking around the place I came to the conclusion that I could repair it in the following manner: I took the chest off entirely and cleaned off the old gasket thoroughly. I then cut two new gaskets of 1-16-in. packing that would fit under and over the steam chest. As one side of the chest was cracked open, I sprung this crack as much as possible and inserted a piece of packing 1-32-in. thick, making sure that

it stuck out through the bearing sides of the chest. There being no way to put a clamp around the chest, I got two pieces of iron 1½-in. x ½-in. x 4: long and punched a ⅝-in. hole 1¼-in. from one end on each strap. I then got a bolt 10-in. long, put it through the holes in the straps. I placed the straps on the chest so that the bolt was against the chest, and cut a piece of ½-in. pipe long enough to go between the other ends of the straps. I tightened up the nut on the bolt, making sure that the clamps drew the chest together onto the packing I had put in the crack.

While I was doing this, I turned the steam on to the chest to heat it as much as possible, so that the softened packing would fill up the crack nicely. After I thought it tight enough I cooled the chest off and then took up the bolt a little more. I then put the chest in place on the gaskets, pulled the nuts down a little and then turned the steam on and pulled the nuts down a little more. I waited until it cooled a little and pulled the nuts up for good. I stayed there that night, and the next morning we took up the joints all around the pump and it worked all right. It is working yet, and will a long while, if they keep the frost out of it.

Depew, N. Y. DUNLAP.

Rodney's Troubles.

Or Do We Need a License Law in Michigan?

(Fifth Letter.)

Mistur editur, i wont tu thank u fur the way u shode me how the pump wurks and the way u told me to be kairful about the grait bars and such things. now i hev a stikker to ask u and i hoap u wil be abel tu anser me rite away fur i am in a hurry tu no. My bruther henry and me was arguin thu uther day about the heet and the kold and we kep at it til i begun tu think thet u wus the onle 1 tu tel us the rite about it. i asked henry whut heet wus and whut kold wus and he sedd the heet wus ackspanshun and kold wus kontrakshun, or sumthing lik thet. He sed thet heet wud mak ennything biggar lik, swel it out like puttin watter in dride apuls, u no how thet makes them swel up, then he sed thet kold wus kontrakshun and when enny think got kold it got smaler. now rite hear iz whur we got inter the jangul, fur mr editur i hev prufe thet he iz rong, the other mornin whun i went out tu mi mushene tu see if evri thing wus al rite i found 1 ov the pipes leeding frum the pump whut u shode me about the watter hammer on, frum thear to the biler, wus frose tite and solid with ise and busted fur a futt or moar, now this iz jist whut makes me think thet henry is rong about hot and kold, i think thet the kold hes as much eckspanshun in it az the heet any time, u will du me a very kind favur if ule send me a ansur by the registurde lettar sistem so ile no jist who the lettar iz frum. i don't want henry tu no ani thing about it so pleeze be shure and send the lettar to me.

rodney gumkirk

orkners corners

Meeshigan

munrow kounty

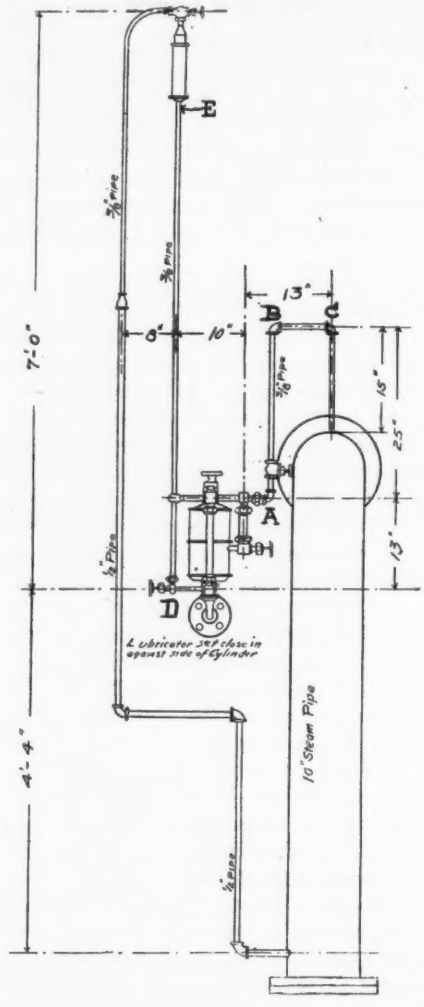
cair of my fathur.

The Sight Feed Lubricator.

EDITOR THE PRACTICAL ENGINEER:

In looking over January number of "The Practical Engineer," I saw a sketch of a lubricator that will not work. I will try and give you my idea why it will not:

As I understand the working of the lubricator, the pressure entering the ⅜-inch pipe forces the oil through a 3-64-inch hole up through the feed glass of water. When the oil reaches the surface of the water in the feed glass, it meets a pressure of the same force that drove it out of the reservoir of the lubricator and comes to a standstill, as the



pressure is equal. So by looking at the sketch it can be seen that the lubricator is in a trap and the oil can't get out as it will not run up the tube AB. Suppose the pipe DE is made 25 inches shorter and the pieces of pipe AB and BC taken out. Cut off AB so as to be about 11½ inches long, keeping the piece with the globe valve in and connect A and C.

Now as the oil floates to the top of the water in glass it will run along pipe AC and down into the cylinder. This lubricator would work in its present condition if it would be possible to fill pipe AB with water.

South Tacoma, Wash. G. W. C.

Use of Superheated Steam in Ovens.

EDITOR THE PRACTICAL ENGINEER:

In reply to the inquiry of Mr. J. V. Redmond, on page 21 of the February number, regarding the use of superheated steam in ovens, I would say that I recently designed a hot air oven for a similar temperature, for use where superheated steam had been tried and discarded. The chief difficulty I understood to be that of keeping the fittings tight under the high pressure of the steam at that temperature, approximately 400 pounds per square inch, I believe. Bent pipe was used to get rid, as far as possible, with that trouble.

If heat alone is Mr. Redmond's requirements and the moisture resulting from leaks would not be objectionable, he can probably get satisfactory results if he designs the piping with as few joints as possible, using the heaviest fittings obtainable and of wrought iron, not cast. Careful provision should be made for expansion to take place in length and in bends without causing unequal strains therefrom in threaded joints.

New York, N. Y. E. W. B.

Another Condenser.

EDITOR THE PRACTICAL ENGINEER:

Since Mr. Switzer first made mention of his condenser proposition, he has had ample time to have erected it, and exploded his engine and then taken a trip to Ireland and return, unless somebody has come to his assistance.

W. A. D.'s idea is the most practical as in all jet condensers that I am acquainted with, the steam enters at a higher point than does the water, thus lessening the liability to do damage. There should be an injector valve on the supply pipe to regulate the water supply; also a spray plate and relief valve on the exhaust and the barometrical column or discharge pipe should be at least 30 feet high to support column of water by the pressure of the atmosphere and yet have the condenser itself kept clear for the rapidly descending water which carries the air down into the hot well after it is drawn through the condenser. His pump, he would find, would be of great assistance in starting.

Park City, Utah. W. R. S.

An Hawaiian Island Opinion.

EDITOR THE PRACTICAL ENGINEER:

Under the heading "Does Cold Air Hurt Boilers?" I noticed the discussion of G. W. B. McC. My experience will agree with Mr. G. W. B. McC. in his suggestions concerning an engineer, as he says, that still holds to the idea that cold air don't hurt the boilers while the sheets are hot. In my opinion, I would compare such a man with the farmer who took the pendulum of a clock and asked the watchmaker to fix it. Being asked why he didn't bring the whole clock, he said, "The rest of the clock is all right, but this is the thing that won't go. When I took this off, the clock run like the devil." This shows how much he knew about the clock.

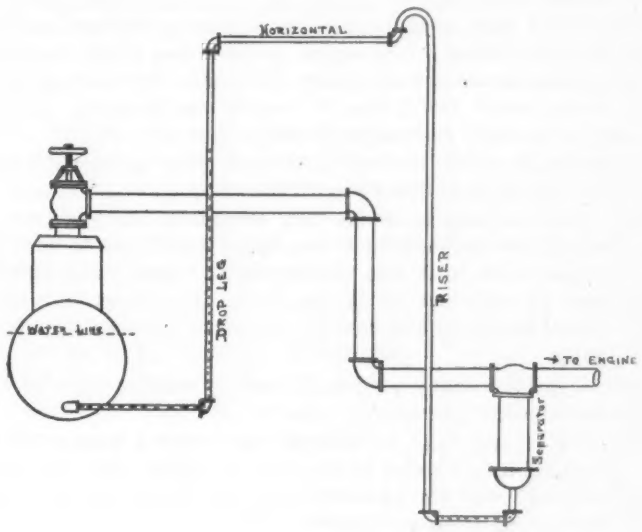
It seems to me, the man that Mr. G. W. B. McC. describes is a little out of his practice. If cold air does not hurt boilers, what are those doors for? Any one would say to prevent cold air from getting under the boiler. The question is plain enough.

Hilo, Hawaiian Islands. J. S. P.

More About the Steam Loop.

EDITOR THE PRACTICAL ENGINEER:

After carefully reading your article in December issue on the steam loop, I fail to see how it will operate without another feature not mentioned in the description. I refer to the check valve, which it is necessary to introduce between the drop leg and boiler. As stated in said article, the steam in the horizontal condenser, reducing the pressure there and allowing the pressure in the separator to force the entrained water up the riser. Now what is to prevent the water from the boiler from rising in the drop leg to fill the vacuum in the horizontal, unless a check valve is placed in the pipe to prevent it. Of course if such a check is used, the horizontal, receiving nothing from the boiler to fill the partial vacuum, must fill from the separator as desired. When the horizontal becomes full of water it naturally flows into the drop leg by gravity and so opens the check valve and passes through.



If any reader has a steam loop operating successfully without a check valve it would be interesting to hear from him.

Alberta, Can. F. H. S.

Sight Feed Lubricators.

EDITOR THE PRACTICAL ENGINEER:

In the January number of the "The Practical Engineer" I have been looking at Mr. A. S.'s lubricator connections. I suppose the engine sets above the boilers and steam is flowing up the pipe. Now if I had that lubricator I would take out that 50 inches of ⅜ pipe from the oil connection on the lubricator to the steam pipe. That connection, usually furnished with the lubricator, is about 6 inches in length, including valve, and it has no elbows in it. One-half inch pipe would be better for that connection instead of ⅜-inch pipe. The steam pipe for this connection should be tapped between the elbows shown in the sketch and the throttle valve, if possible. If the cylinder is not jacketed or if it gives off much heat, the lubricator should not set closer than 9 inches.

Winthrop, Cal. P. H. W.

QUESTIONS and ANSWERS

THE editor will be glad to receive from the readers of THE PRACTICAL ENGINEER, such questions relating to engineering subjects, as may, from time to time, occur to them. All questions and answers should be addressed to the editor and accompanied by the name and address of the writer, which will not be published, however, unless especially desired. It is the intention that questions shall be answered by the readers, and even though the editor may, from time to time, publish answers and questions, he especially desires the readers in such cases to contribute any further information, in connection with the points raised, that they may consider of interest. All questions and answers received by the editor will be published, as far as practicable, but he reserves the right of editing or rejecting any communication.

EDITOR THE PRACTICAL ENGINEER:

Will you please answer the following questions in your valuable journal:

(1) I have a plain slide valve engine located 150 feet from my boiler. The engine drives a 22.5 K. W. constant current dynamo with a belt. I would like to know how much power it will take to run the engine alone. It is a 9-in x 12-in. running 215 revolutions per minute. The piping is all covered with the best asbestos covering and the engine is in first class condition.

(2) We also have the city current in our factory. I would like to know how few lights it will pay to run our engine with, soft coal costing $3.60 a ton. City current cost 13 cents per K. W per hour. The boiler is a horizontal return tubular one, average steam pressure 70 pounds gauge.

(3) How many pounds of coal is usually required per horse-power per hour.

(4) I also have an exhaust fan which I would like to connect to my boiler to increase the draft. How would be the best way to connect it and how much would I gain by putting it on my boiler?

Newark, N. J. C. A. J.

(1) The friction horse-power of an engine or the horse-power that is required to run the engine alone, is a very variable quantity, depending on the kind of valves and eccentric straps and the friction of the packing boxes and bearings. With an engine such as mentioned the friction horse-power would probably be about 3 H. P.

(2) This is a question, which in its broadest sense may be called the finance of engineering and involves such quantities as attendance of engine and boiler, oil waste, supplies, etc., and also the purpose for which the exhaust steam is used. Neglecting these factors, as none are given and taking only the cost of the coal into consideration, it can be arrived at in the following manner:

Assume that the engine uses 4 pounds of coal per horse-power per hour. If the efficiency of the generator is about 90 per cent. this is equivalent to 4.4 pounds of coal per electrical horse-power delivered per hour. A good 16 candle power lamp will use about 56 watts or one horse-power will supply about 13 lamps. It will therefore take 4.4 pounds of coal to keep 13 lamps going per hour, or it will take 6.1 pounds per K. W. per hour. As the coal costs $3.60 per ton, the coal would cost about one cent per K. W. hour.

Comparing this with the cost of the electrical current which is 13 cents per K. W. it can be seen that under any circumstances it would pay to run the engine provided, of course, that the engine can be run without extra expense.

(3) The amount of coal used by an engine per indicated horse-power per hour varies from about 1.75 pounds in a triple expansion condensing engine to 6 pounds in a non-condensing engine while very uneconomical engines use still more.

(4) The method of application of mechanical draft may be done in two ways, either by forcing the air through the fire or by introducing the exhaust fan in the place of a chimney which system maintains a partial vacuum above the fire. The former method is known as the forced draft system and the latter the induced draft system, and either method of application must depend upon existing conditions. Some of the principle advantages of mechanical draft when used with a chimney are as follows;

Under favorable conditions, the horse-power of the boilers may be increased to about 25 per cent. more over that obtained with natural draft. Inferior fuel may be used. The draft is entirely independent of the weather and climate and in some cases economy of fuel may be obtained. Its principal advantage, however, is that it fills a necessity. There are many plants whose chimneys are too small and there is not sufficient draft to give the requisite power, sometimes for future and sometimes for present use, and instead of rebuilding a chimney or making it higher, mechanical draft is used.—[Ed.]

EDITOR THE PRACTICAL ENGINEER:

Please answer through your paper the following questions:

1. In the power house where I work they operate mechanical stokers using slack coal. The fireman claims that in wetting the coal all it will take, it will give out more heat than if it were used dry. If so, will you please explain why?

2. How do you determine a high speed engine.

Kansas City, Mo. L. K.

1. It is a mistaken idea that coal will give out more heat when wet than it will when dry. This water in the coal must be raised from the temperature of the coal to that of the furnace and the only way that this can be done is to abstract the necessary heat from the furnace. Its advantage is supposed to be in the fact that when this water is turned into steam at the high temperature of the furnace the steam will disintegrate into its elements of hydrogen and oxygen. The hydrogen is then supposed to burn giving off heat and the oxygen is supposed to aid combustion. It is generally agreed, however, if this does take place, that it will not give out any more heat than was taken to evaporate the water into steam and to disassociate its elements.

2. High speed engines are divided into two classes, engines with high rotative speed and engines with high piston speed. A long stroke engine, which has a low rotative speed will usually be an engine having a high piston speed. A short stroke engine having a high rotative speed will often be an engine which has a low piston speed. The classification as to whether an engine is a high speed one is entirely arbitrary and comparative. An engine is said to

have a high piston speed when the piston travels more than 900 feet per minute and a high rotative when the crank revolves more than 120 times per minute.—[Ed.]

EDITOR THE PRACTICAL ENGINEER:

1. When figuring the heating surface do you figure on the area of the inside or outside of a boiler tube?

2. Will an oil fire hurt the tubes of a fire tube boiler if the blaze is allowed to strike the ends or should the ends be rolled over?

Pierce, Texas. E. A. S.

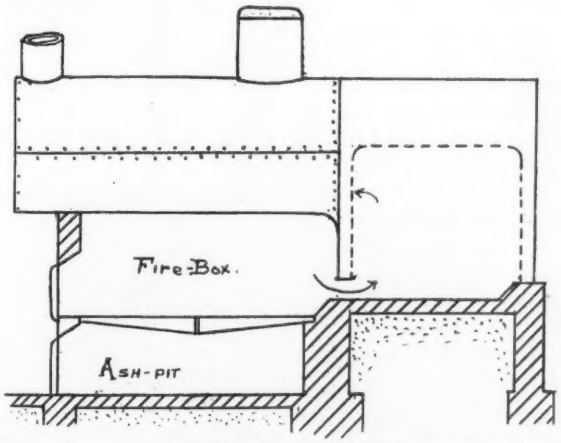
1. The best engineers are not agreed as to the methods of measuring the heating surface of steam boilers. The usual rule is to consider as heating surface all the surfaces that are surrounded by water on one side and by flame or heated gases on the other, but there is a difference of opinion as to whether the tubular heating surface should be measured from the inside or from the outside diameter. Some writers says, measure the heating surface always on the smaller side—the fire side of a tube in a horizontal return tubular boiler, and the water side in a water tube boiler. Other engineers say that the true heating surface of a tube is the side exposed to the hot gases—the inner surface in a fire tube boiler and the outer surface of a water tube boiler.

2. As your boiler is a fire tube boiler, it would be better to roll the ends of the tube over. The flames in striking the ends would deteriorate them unless they could transmit as much heat as was given to them by the flames. If not, the ends would overheat, causing oxidation and hence deterioration.—[Ed.]

EDITOR THE PRACTICAL ENGINEER:

Is it safe to fire a locomotive boiler as a return tubular boiler as shown in sketch. It is used for running a shop and burns shavings.

Stone, Vt. W. G.



There is no reason, if other conditions are satisfactory, why this locomotive boiler will not be safe to run as shown in sketch.—[Ed.]

EDITOR THE PRACTICAL ENGINEER:

Please answer in your next issue the following questions:

1. Can a vacuum be impaired in a jet condenser by having too much water?

2. Can a 110 volt 50 K. W. dynamo be reduced to 55 volts, and at the same time get 50 K. W. out of same, and if so relate how?

St. Louis, Mo. E. A. D.

1. A vacuum cannot be impaired in a jet condenser by using too much water, except when flooding is allowed to take place. This usually happens when more water is used than the air pump is able to take care of. In well designed air pumps, this flooding is prevented automatically, so that as soon as the level of the water reaches the spray pipe and the spray becomes submerged the condensing surface is reduced to a minimum, so that condensation does not take place. The exhaust pressure of the engine breaks the vacuum and the exhaust steam escapes by blowing through the injector pipe and through the valves of the pump and out at the discharge pipe forcing the water ahead of it; consequently flooding does not occur.

2. If this dynamo is a direct current machine, the voltage cannot be reduced and the current increased, without rewiring or redesigning the machine.

It is probable that the conductors on the armature would overheat, as the current would have to be doubled to get the same output. The voltage can be reduced by either decreasing the field strength or decreasing the number of revolutions, and the current can be increased as much as the capacity of the conductors on the armatures will stand. As the heat generated by an electric current varies as the square of the current, doubling the current increases the heat given off four times.

If the machine is an alternating current machine, a transformer would give the desired results. The voltage can be decreased to 55 volts and the output remain at 50 K. W., the only loss being that due to the small loss within the transformer, the efficiency of an average transformer being about 95 per cent.—[Ed.]

EDITOR THE PRACTICAL ENGINEER:

Kindly answer me the following question: Why do you use the zinc plates in the boiler to prevent the incrustation? Does it not hinder its circulation.

St. Louis, Mo. J. A. G.

The discussion of this subject will be found under the head of "Zinc, Scale and Corrosion" in another column of this issue.—[Ed.]

Injectors.

The failure of injectors to work may be due to a variety of causes. The most common of these is the presence of air in the suction pipe, due to leaks in the joints or improper packing of valve stem. The suction pipe must be made air tight and the end of the pipe must be submerged in water, otherwise air will be sucked in and the injector will not work. Sediment and scale in the nozzles are other causes of injectors failing to work. When the injector fails to get water there may be a leak in the supply pipe, the water supply may be cut off, the strainer may be clogged up, the water may be too hot, or the pressure may be too low for the required lift. If it gets water but fails to force it into the boiler, the water supply is probably not properly adjusted to the steam supply, or it may be due to an obstruction in the check valve, the boiler feed pipe, or the delivery tube of the injector. If it starts to feed water into the boiler, but breaks, the fault may lie in any one of the above causes, or it may be that a globe valve in the supply pipe has a loose disc which partly closes the valve after the injector is started. This may be remedied by reversing the valve.

The "Economic" Condensing Exhaust Head.

The accompanying cut illustrates an exhaust head in which some new and desirable features have been included in its design. It fulfills the functions for which an exhaust head on steam escape pipes is especially required, that is, the prevention of spray, carried out with escaping steam or produced by condensation in the atmosphere, and the elimination of any noise due to the pulsation of the engine from which the steam is escaping.

The steam is, in this head, first freely expanded within the upper dome, whence it, with all the contained moisture or oil escapes downwards through a large number of vertical pipes, so proportioned that there is no retarding of the steam. These pipes present a very large surface to the atmosphere which gives considerable condensing effect. The descending vapor passes down in the same direction as the moisture and condensation, and carries both to the water level of the open tray which forms the lower part of the exhaust head. The remaining vapor is so freely expanded that it floats off practically dry. The condensed water is returned automatically from the lower part of the head by a return bend drip pipe, there being another pipe to lead the scum and impurities away. The condensed water is usually led to some point where it can be returned to the boilers.

The apparatus operates upon the principle of a large expansion of the escaping steam, its free and unobstructed exit in the same direction as its contained moisture, and on the free reception of the water below the point of emergence of the remaining vapor. The economic results produced by

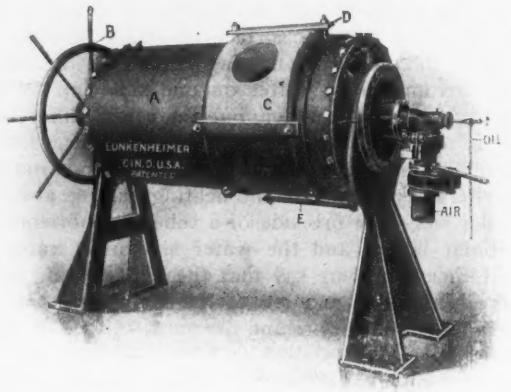
the condensation of the exhaust steam and the reduction of the back pressure is said to save one and one-quarter per cent. of the whole power of the engine.

These exhaust heads are usually made in sizes varying from a 5-inch exhaust pipe to a 20-inch. Any further information may be had by applying to the manufacturers, Thorpe, Platt & Co., 97 Cedar Street, New York.

The Lunkenheimer Metal-Melting Furnace.

The illustration herewith shows the Lunkenheimer Metal Melting Furnace, which has been found to afford a very efficient and economical method of melting metals, particularly brasses and bronzes.

This type of furnace was evolved after considerable ex-



perimenting with nearly every type of furnace on the market, and is the result of considerable study on this subject. As will be seen from the cut, the furnace consists of a cylindrical sheet-steel drum A, having cast-iron heads. The interior of the drum is lined with fire-proof tile, and there are two openings on opposite sides of the drum. Only one of these openings is in use, the other being closed by a fire clay filling. The object of having two openings is to increase the life of the linings of the furnace. It has been found that the furnace wears out quicker around the filling hole (which also serves as outlet for the flame) than elsewhere. The advantage that the Lunkenheimer metal melting furnace has over all other makes is that when one filling hole is worn out, this can be closed by a fire-clay filling and plate, the furnace reversed, and the other hole cut out and put in service.

The oil burner is of a special type, designed to give the greatest amount of heat with a minimum consumption of oil. In the Lunkenheimer foundry there are ten of these furnaces in use, and they are able to secure from six to seven heats per working day of ten hours from each furnace. The weight of each heat will average about five hundred and fifty pounds, and the oil consumption varies from two to two and one-half gallons of crude oil per hundred pounds of metal melted.

The life of the linings is from three to four hundred heats, this varying with the kind of metal melted. The whole furnace is of a heavy and substantial construction, and will be found very durable. On account of the simple form of the tile it is very easy to re-line, an objection which was found in some other types of furnaces.

The Lunkenheimer Co. will be pleased to figure on complete equipment as shown above, and, on account of extensive experience, they claim to produce better results than any other type of oil furnace.

With the first furnace sold to each customer within a radius of one thousand miles of Cincinnati, they will send

an expert to start the furnace and take off the first heat, and instruct the furnace-room employees as to how to secure best results in handling, etc.

This furnace is made in two sizes, the No. 1 size having a capacity of five hundred and fifty pounds of metal per heat, and the No. 2 size having a capacity of twelve hundred pounds of metal per heat.

The Lunkenheimer Company, of Cincinnati, O., will be pleased to furnish prices upon appilcation, and give any other information that may be desired.

Two Cylinder Steam and Air Motor.

The uncertainty of available power sources for driving portable machines has led to the design and construction of this small and compact motor. H. B. Underwood & Co., of Philadelphia, have naturally experienced great difficulty in obtaining suitable power for this purpose, owing to the fact that one of their special lines of work is that of repairing stationary, marine and locomotive engines, as well as other types of machinery, which cannot be conveniently sent to the machine shop. It is to overcome this difficulty that this company has designed this small and compact motor shown in Fig. 1. It may be driven either by steam or compressed air, one or the other of which is almost sure to be available wherever this motor is to be used. The engine is readily portable, being mounted upon a base which may be fastened by any convenient means so as to hold the

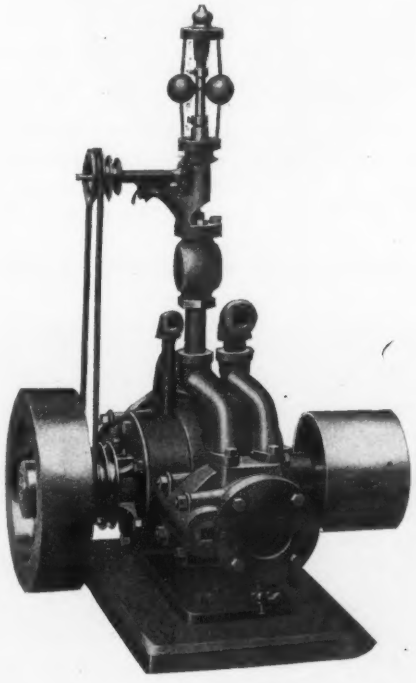


Fig. 1.

motor while in use. The floor space required by the motor is 19 x 19 inches; its height from the base to the extreme top of the governor is only 30 inches, and the weight of the machine complete is about 145 pounds.

The principal of the motor involves the use of two single acting cylinders placed in line, one on either side of the crank shaft. In each cylinder is fitted a trunk piston L, Fig. 2, and from the two pistons lead connecting rods, M, working upon one crank pin. The construction of the connecting rods and the method of their attachment to the single crank are ingenious. Referring to Fig. 2, it may be seen that each connecting rod has at each side of its crank pin end a segmental flange or shoulder, P. In making these connecting rods, which are of brass, the two are cast in line

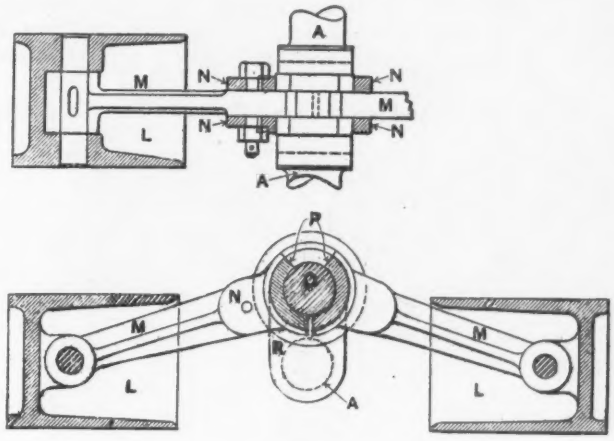


Fig. 2.

together, with the crank pin hole cored at the middle of the straight casting. This double rod is then machined in one piece, the middle hole being bored for the crank pin hole and the complete rings or shoulders P being turned up to proper dimensions. The casting when finished is then cut in two. Each cylinder of the engine being single acting, the connecting rods are alternately in compression, exerting thrust against the crank pin. As they are never in tension, the sole duty of the two brass rings N is to effectively secure the connecting rods in position against the crank pin, both laterally and longitudinally, and therefore never have to bear any stresses due to the driving load.

The distribution of the steam or air is controlled by piston valves actuated by an adaptation of the Scotch yoke principle, the admission of the working fluid to valve chests being done by means of a twine pipe connection from a single pipe to which is fitted a small fly ball governor. A cone pulley is attached to the governor so that any speed can be maintained, the usually running speed being between 200 and 400 revolutions per minute. At the latter speed, the engine will generate about two horse-power. The crank shaft is a solid steel forging 1¼ inches in diameter and is so neatly balanced as to allow the engine to run at a speed of 400 revolutions per minute with very slight vibration.

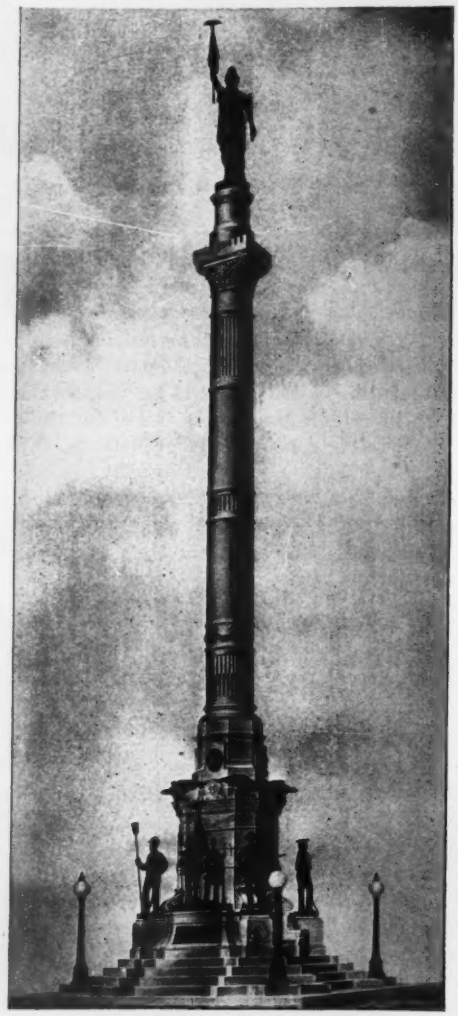
The engine is designed upon lines conducive to economy and durability, the aim being to make this machine equal to an electric motor for general convenience and more useful in a great many cases where steam or compressed air is available and the electric current cannot be had. The engine is intended for use under working pressures of from 50 to 150 pounds. The fly wheel, belt pulley and governor can be quickly detached and the bulk of the machine thereby materially reduced for convenience of shipping and handling. The crank case is air tight and dust proof. Both the valves and pistons are comparatively long, giving good bearings and preventing excessive wear. The pistons are 3 inches in diameter and stroke is 3½ inches long.

ALLENTOWN.

The Convention City For the American Order of Steam Engineers.

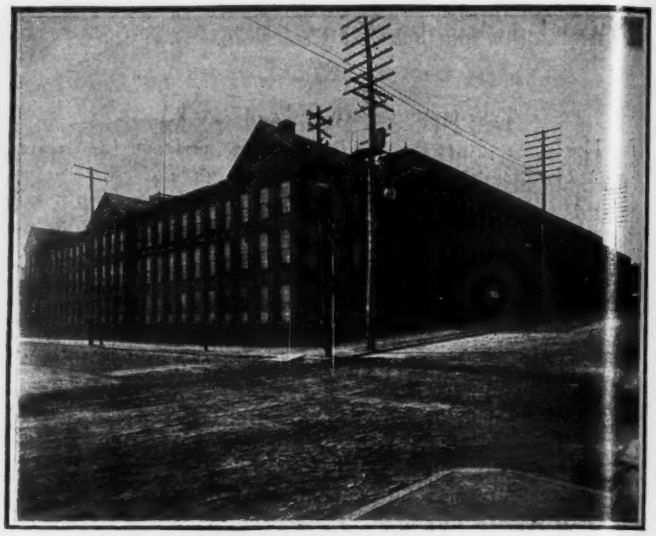
Allentown, Pa., where the next annual convention of the American Order of Steam Engineers is to be held, during the week commencing May 9th next, is not only a beautiful city of 40,000 inhabitants, and a centre of vast industries, but it is the metropolis of the Lehigh valley, the fame of which through song and verse has been spread throughout the land.

In point of size and population Allentown is 113th among



Soldiers and Sailors Monument in Centre Square.

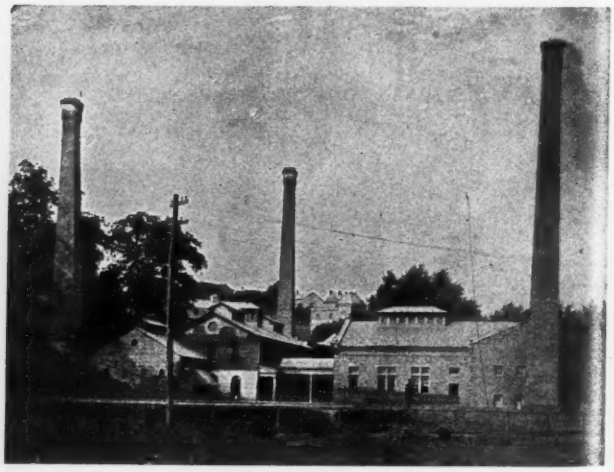
the cities of the United States. It is about sixty miles north of Philadelphia on the junction of the Lehigh, the Little Lehigh and the Jordan rivers. Some three miles to the south is the low-lying Lehigh mountain, while the Blue Mountain range lies eighteen miles to the north. Four railroads and a trolley system of unusual perfection connect Allentown with the outside world, included with the latter is a through line to Philadelphia over which fast express cars travel on regular schedule time, carrying passengers a distance of sixty miles in comparative luxury for fifty cents. A dozen other lines extend for miles in every direction, terminating or connecting with other roads at Bangor, Egypt, Easton, Freemansburg and other neighboring towns, several of the lines passing through the great cement district lying just to the north and east of Allentown. This latter, by the way, is very interesting and will



The Big Adelaide Silk Mill.

no doubt be visited by many of the delegates to the coming convention. The big cement plants dotting the country at short intervals are veritable giants of industry, amazing the casual visitor, and producing many thousands of barrels of cement every twenty-four hours. Most of these plants are operated at their full capacity, night and day all the year, yet the demand for cement continues to exceed the supply.

The people of Allentown are noted for their thrift, their



The Allentown Water Works.

hospitality and their jovial manners. During work hours everybody works, at other times they play. The streets are seldom crowded in day time, but at night they glitter

with light and gaity, and are filled with merry crowds.

The industries represent investments of more than eleven millions, among which are included seven or eight silk mills, including the great Adelaide mills, which are among the largest in the world. Another of the city's largest industries is the big plant of the American Steel and Wire Company.

There are also several furniture factories, shoe factories, large cigar factories, breweries and other industries of endless variety, all of which make Allentown an appropriate city for a convention of men accustomed to having charge of industrial power plants.

Lehigh Council No. 15 are making elaborate preparations for the convention. They have selected a central committee composed of A. P. Dreisbach, A. J. Strauss and Edmund Brader. These are three excellent men and the good results of their work is assured. Headquarters will be at the Hotel Allen.

CONVENTION COMMITTEE.
A. P. Dreisbach
A. J. Strauss. Edmund Brader.

In connection with the convention there will be an exhibition of machinery and engineers' supplies, for which the committee will provide an appropriate hall. Space will be free to those desiring to exhibit their products.

Any further information or details desired may be had by addressing the Convention Committee, A. O. S. E., 607 Hamilton St., Allentown, Pa.

Maryland Council.

The new officers of Maryland Council No. 1, of Baltimore, are as follows: Chief Engineer, Frank P. Denton; Assistant, Andrew Bichell; Recording and Corresponding Engineer, Jno. J. McKewen, 115 N. Ann St.; Financial Engineer, James Gardiner; Treasurer, Peter Hagan; Chaplain, M. T. Guthridge; Senior M. M., Hugh Dolan; Junior M. M., H. A. Flaherty; Sentinels, Geo. Crum and M. J. Doyle; Trustee, J. L. Bichell; Delegate, A. J. Deitrich; Alternal, Lewis Smithers.

The Allentown City Hall.

Kensington Council.

The newly elected officers of Kensington Council No. 3, A. O. S. E., of Philadelphia, are as follows: Chief, Wm. Davis; Assistant, Jas. McCartney; Senior M. M., Thos. Donovan; Junior M. M., Richard Lee; Treasurer, Chas. Cook; Financial Engineer, H. R. Myers; Recording Engineer, Edwin Ricker; Corresponding Engineer, Geo. W. Kennedy, 2052 East Fletcher St.; Sentinels, Joseph Wooley and John Crean; Trustees, John Martin, Wm. Stott and Ernest Ritsert.

Allentown Plant of the American Steel and Wire Works.

A New Electrical Book.

Modern Wiring Diagrams and Descriptions for Electrical Workers, by Henry C. Horstmann and Victor H. Tousley. D. Van Nostrand & Co., 23 Murray St., New York. 160 pages, illustrated. Size 4 x 6. Full seal leather bound. Price $1.50.

This book is intended as a handbook of practical electrical diagrams and information for electrical construction work. It is refreshing to see that this book does not contain any definitions of the fundamental electrical units, it being assumed that these are too well known to need description, nor does it contain any historical matter or matter that is not of practical use

It describes clearly how to install and manage batteries and how to test them; how to wire for annunciators, the telegraph and gas lighting and how to test circuits and locate trouble. It explains alternating and direct current dynamos and motors and describes the "compensator" and storage battery installation. A clear description of the "Wheatstone Bridge" and its uses in testing is given as well as voltmeter and other testing.

The book is well illustrated throughout, and they explain clearly all the different subjects described. It should be a valuable book to any one that does electrical work as it not only tells how to do it but shows how.

A German Pocket-Book on Electric Street Railways.

A very neat pocket-book written in German has just been received from Germany. It is entitled "Elektrisch betreibene Strassenbehnen," and is a reference book on th calculation, construction and design of Electric Street Railways. It contains 500 pages of reading matter, 337 illustrations and 4 tables of mathematics, which are very useful in electrical calculation.

It is published in Munich and Berlin, Germany, by R. Oldenbourg. Price 8 marks, which is equivalent to about $2.00.

Preparing For the Richmond Convention.

A party, including Secretary Raven and Treasurer Wilson, of the N. A. S. E., and President Martin and Secretary Sly, of the National Supply Men's Association of the U. S., were in Richmond, Va., early in February to arrange details in connection with the coming N. A. S. E. Convention, to be held in that city the first week in August. They found Richmond an ideal city for such a convention, and the local engineers, supply men and business interests very enthusiastic. A call was made upon Mayor Taylor, who assured the Committee that every courtesy would be extended and that every effort would be made to make visitors to this convention long remember Richmond. Murphy's Hotel was selected as headquarters. Meetings of the N. A. S. E. will be held immediately across the street from the hotel, in the Bijou Theatre, and the Richmond Armory, which is near by, will be used as the exhibit hall.

Reading, Pa.

At their regular meeting on Dec. 26th, Progress Council No. 13, elected the following officers, who were installed by Grand Chief Trout, on Jan. 9th: Chief Engineer Fred. M. Keterer; Asst., Edw. Jones; Corresponding Engineer, F. S. Miller, 3 Franklin St., West Reading; Financial Engineer, Geo. F. Moyer; Treasurer Engineer, A. B. Hess; Chaplain, Jacob Stover; Sr. M. M., J. F. Shadle; Jr. M. M., Walter M. Walters; Inside Sentinel, Jos. Livinghouse; Outside Sentinel, Jas. F. Ferries; Trustee, John Moyer; Delegate to Grand Council, A. B. Hess.

Rules.

1.—When you enter the engine room, spit on the floor. We have water, lye, soap, mops and brushes, and we will clean up as soon as you leave.

2.—Rub your hand on all polished work. It will give some one work and use the surplus polish.

3.—Put your hands on engine's bright work. You will then know if it is smooth, hot or cold. Tell others to do the same.

4.—Stay in the engine room as long as you please. The engineer has nothing to do but entertain visitors.

5.—Be sure to tell the engineer if his engine is pounding or running right, as he will not know it unless you do. He will stop and make repairs while you wait.

6.—Don't tell the engineer who you are. He is a mind reader and already knows you. Go anywhere in the engine room, and you will please him.

7.—Advise him what to do, as you know best. The engineer is only there every day, and does not have a chance to see as much as you will in an hour.

8.—If the engineer is busy making repairs, tell him a good story you heard the other day, and if possible, get in his way.

9.—Be sure and tell all you know. It won't take long.

10.—Call again, and repeat as above.

The above "Rules" are copied from a card, size 6-in. x 8-in. which is issued by The Pittsburg Fuel Saving Co., 522 Second Ave., Pittsburg, Pa.

The company will be glad to send one of the cards to any engineer who desires to tack it up in his engine room. They will also mail a booklet describing a rather unique patent furnace which it is claimed will increase the boiler capacity 30 per cent. and save 10 per cent. in fuel.

Old Colony.

Following are the new officers of Old Colony Council, Rockland, Mass.: Chief Engineer, H. W. Jones; First Assistant, Thos. W. Sharpe; Recording Engineer, W. H. Perham; Corresponding Engineer, Walter A. Randall; Treasurer, Chas. Scott; Chaplain, Wm. H. Hammond; Senior M. M., Joseph Bryant; Junior M. M., Francis Caldwell; Sentinels, Donald Inkley and J. F. Bosworth; Trustee, W. H. Hammond; Delegate to Supreme Council, E. H. Naylor.

Mr. J. K. Sedgwick, who has been an active worker in Old Colony Council since its beginning, has retired from office, having held the office of corresponding engineer for seven years. Mr. Sedgwick has always been an active worker for the interest of the council and his assistance has been an important factor in its success.

Many of our readers will learn with regret of the death on January 25th of Thos. Dawson, who for many years has been an active member of Philadelphia Council A. O. S. E. Some years ago Mr. Dawson was a conspicuous figure in the local affairs of the American Order. He was an enthusiastic worker and popular with all who knew him.

TRADE NOTES

Mr. Thos. G. Kehogh, of New York, has accepted a position as traveling salesman with the Standard Gauge Manufacturing Co., of Syracuse, N. Y., with offices at 141 Broadway, New York. Mr. Keogh is well known to many readers of The Practical Engineer, having been for the past five years with the old and well-known firm of Jas. L. Robertson & Sons, of New York, during which time he made many friends among engineers throughout the Eastern part of the United States. In his new position Mr. Keogh will travel extensively and will meet his old friends anew. His new line will consist chiefly of high grade pressure and vacuum gauges and other appliances for engines and boilers.

A neat little circular describing "It Oils" piston packing has been issued by the Weaver Steam Packing Co., 144 North Seventh St., Philadelphia. Copies will be mailed to any engineer for the asking.

The Lagonda Reseating Machine for cleaning the caps of water tube boilers saves a lot of time and insures a perfect joint, two features worth consideration, an illustrated circular giving description and all necessary information will be mailed to any one mentioning this journal. Address Lagonda Mfg. Co., Springfield, Ohio.

The Hartford Blower Co., Inc., 128 Suffield St., Hartford, Conn., has recently completed a large Shaving Exhaust System for the Aeolian Co., Meriden, Conn. This system consists of a double 60 in. Hartford Patent Adjustable Exhaust Fan, one large Hartford Patent Dust Collector, Piping Hoods, etc., connecting each wood-working machine removing the shavings, saw dust, chips, etc., as fast as made, automatically feeding them into the furnace.

This same company has just received a second order from the G. F. Warner Mfg. Co., New Haven, Conn. This order is for an Exhaust System, for removing the dust from tumbling barrels, and is practically a duplicate of the one installed a short time ago, with the exception that there will be installed a Hartford Patent Dust Collector, into which will be blown the material from two fifty-inch exhaust fans.

When large firms placed seccond, third and fourth orders, it speaks well for the Hartford Patent Adjustable Exhaust Fans Dust Collectors Exhaust System, Mechanical Draft Apparatus, etc. This company designs and gives estimates free of charge to those interested, and a letter to them will receive prompt attention.

In presenting their catalogue, No. 7, the Lee Injector Manufacturing Co., of Port Huron, Mich., desire to call attention to the number of new and improved articles which have been added to their list during the past year. The Lee Restarting Injector has gained its present position purely through merit. and was awarded a silver medal and diploma at the Paris Exposition, in 1900, and their Ball Check Valves are said to be the most popular and best selling check valves on the market. Catalogue No 7, besides describing the different articles manufactured, contains much information of value to the engineer, such as a table of the properties of saturated steam, a table of useful information containing very valuable data and an article by Mr. William O. Lee, on the "Uses and Abuses of the Injector." The Lee Manufacturing Co., of Port Huron, Mich., will be pleased to furnish this catalogue upon application.

Power and Mining Machinery Company, of 52 William St., New York, has now been merged with the Holthoff Machinery Co., of Milwaukee, Wis. They are making extensive improvements and additions to their Milwaukee plant to meet the increasing demand for the American Crossley Gas Engine, Loomis-Pettibone Gas Apparatus and Holthoff Mining Machinery.

The Loomis-Pettibone Gas producers have established for themselves a world-wide reputation as the only gas producers successfully generating a fixed gas for power and metallurgical work from either anthracite or bituminous coals, coke or wood. The Crossley Gas Engine, built by this company, has had an extensive sale, there being over 50,000 in operation. The Power and Machinery Co.'s guarantee to produce power with a consumption of one pound of good bituminous coal per brake horse-power per hour cannot fail to be of interest to all users of power.

A neat little catalogue has just been issued by the General Specialty Co., 76 Carroll St., Buffalo, N. Y., and will be furnished free upon application. It describes an excellent method of ridding a return tubular boiler of its arch enemy, scale. The tube of a fire tube boiler is so inaccessible that it is impossible by ordinary means to find out its condition either as to strength or as to freedom from scale. The "Torpedo" cleaner, manufactured by the General Specialty Co., does both and at the same time. A boiler can be cleaned and tested in one-half day. They also manufacture the "Demon" rotary, water-driven cleaner, which is entirely different from every other water tube cleaner made, and is said to stand in a class by itself.

Stephenson Bar Belt Dressing is winning praise from woodworkers. This is saying a good deal when the dust problem is considered. Here is a letter from D. L. Rigdon & Son, of Statesboro, Ga., dated January 29, sent to the Stephenson Mfg. Co., Albany, N. Y.: "We received your letter a few days ago, also the box of Stephenson's Bar Belt Dressing, and we certainly like it, and it is far superior to anything we have ever used. Say you write to our hardware man about your Dressing. He could sell it right along here, as there are several factories and saw mills, and if they found it out it would be nothing to sell them. We believe Raines would treat you right, and we certainly indorse Stephenson Bar Belt Dressing." Mention this paper and you can get a free sample for the asking by writing to Albany, N. Y.

Dodge & Day, modernizing and contracting engineers, Nicetown, Philadelphia, Pa., are installing in the power house of the Link-Belt Engineering Co., Philadelphia, Pa., a 340 h. p. Buckeye vertical cross-compound engine, direct connected to two General Electric 100 k. w continuous-current, compound-wound generators.

The boiler plant at the same establishment is also receiving attention, and while it may not be found necessary to increase the capacity, it is probable stokers will be introduced.

The Taylor system of management is well under way at the Link-Belt works, and the results attained have been most gratifying.

A handsome new calendar for 1904 has been issued by McLeod & Henry Co., Troy, N. Y. Send for one. The attractive feature of this calendar is a beautiful engraving, showing portraits of all the Presidents from Washington to Roosevelt. We understand that the supply is limited, so write quick if you want one, mentioning The Practical Engineer. McLeod & Henry Co. are manufacturers of patent boiler door arches which may also interest you.

The McClave-Brooks Company, Scranton, Pa., have opened a branch office at 1011 Girard Trust Building, Philadelphit, with Mr. Chas. S. Davis in charge.

The Manheim Casting Company and the Baum Separator and Machine Company, of Reading, Pa., have consolidated their interests and will hereafter conduct business as the Baum Separator and Machine Company, Inc., of Manheim, Pa. The Reading office will be discontinued, and hereafter all business will be conducted from the Manheim office.

In addition to the manufacture of the Baum Steam and Oil Separators they are equipped to furnish all kinds of light and medium heavy grey iron casting at reasonable prices.

The 1904 catalogue of the Knowles Steam Pump Works, 114-118 Liberty St., New York City, is a book of about 150 pages showing nearly half as many full-page illustrations of different types of direct-acting steam pumps for boiler feeding, mine drainage, waterworks service, etc., also electric and belt-driven pumps. artesian well pumps, air compressors and ammonia pumps, both fly-wheel and direct-acting, jet condensers, relief valves, air and circulating pumps, wrecking pumps, vacuum pumps, sugar-house pumping machinery, etc., in fact, pumping machinery of every type and for every purpose found in engineering work. This catalogue will be supplied free upon request to those interested.

Those who are using the Simonds Improved Receiver and Separator appear to be highly pleased with the results obtained. The Alabastine Co., of Grand Rapids, Mich., equipped the main steam line to an 18 x 42 Corliss engine with the Simonds apparatus about a year ago. They now write that it is giving great satisfaction, having entirely overcome the problem of "wet steam" and vibration in the long pipe line. The Carrom-Archarena Co., Ludington, Mich., also write in praise of the Simonds apparatus. Mr. Simonds has received orders for this Receiver and Separator from the Imperial Furniture Co., Grand Rapids, for 200 h. p. engine; second order from Advance Thresher Co., Battle Creek, for 250 h. p. engine; Widdicomb Furniture Co., Grand Rapids, for 300 h. p. engine; the Columbia Water & Light Co., Columbia, Tenn, for 150 h. p. engine. Descriptive circular may be had by writing to Frank A. Simonds, 421 Houseman Building, Grand Rapids, Mich.

Capt. J. E. Doughty was a welcome visitor at the office of The Practical Engineer one day last month. The Captain is so well known to Philadelphia engineers that any explanation as to his identity would be superfluous. Having sold Lord's Boiler Compounds for twenty years, during which time he has doubtless visited every engine room in or near this city, and possessing an attractive personality, it is quite natural that many of the "boys" should look upon him as an old friend. He has doubtless been in contact with the engineers of this city for a longer period than any other salesman connected with the steam plant trade. Large, handsome, and always faultlessly groomed, he is often spoken of as the Beau Brummel of his profession. He possesses an intricate knowledge of chemistry as applied to boiler feed waters, and is an enthusiastic advocate of Lord's Boiler Compounds.

All engineers are on the lookout for a good sheet packing, as this form of packing has ever been a source of trouble to the engineer. The India Rubber Company, of New Brunswick, N. J., have recently erected one of the argest and best equipped plants in the United States, and as their machinery is all new and of the most modern type their motto is "Quality." It is therefore not surprising that their "White Seal" Sheet Packing has proved itself a wonder in its tests on steam flange work. It is especially adapted for packing joints where high pressure is used.

It is said that "White Seal" will not blow out under the highest pressure and will make a perfectly tight steam, air or cold water joint; that it is not affected by oil, liquor, ammonia or alkali, and does not become hard or brittle, but retains its tough and elastic properties.

Catalogue No. 10, just issued, is the handsomest rubber goods catalogue that we have seen. A copy of it will be sent free to any engineer who mentions The Practical Engineer. Address the India Rubber Co., New Brunswick, N. J.

W. H. Wilkinson Co., formerly of Boston, Mass., have removed to West Medway, Mass., where they now occupy handsome new shops equipped with the latest improved tools and machinery.

The Pittsburg Fuel Saving Co., 522 Second Ave., Pittsburg, Pa., have issued a neat little catalogue describing a new furnace which they say will increase the efficiency of your boilers 30 per cent. The catalogue explains. Send for a copy if you are interested.

The Mineral Point Electric Light Co., at Mineral Point, Wis., write that they have cleaned the tubes of two return tubular boilers with a Torpedo Cleaner, and have taken out three kerosene barrels full of scale. They say they expect to save about one-half their fuel, and are naturally very well pleased with the Torpedo Cleaner. This cleaner is especially adapted for fire tube boilers. Any one troubled with the scale problem should learn more about it. The manufacturers issue a booklet which describes and illustrates it. A copy will be sent free upon request. Address The General Specialty Co., 75 Carroll St., Buffalo, N. Y.

The American Water Softener Company, of Philadelphia, have, at the first of the year, opened a branch office in the Outlook Building, Columbus, Ohio, which office is in the immediate charge of Mr. W. H. P. Fisher, general sales agent for the company, and Mr. A. C. Tomlinson, manager of the Columbus office, who for some time was the assistant manager of the Philadelphia office.

Mr. Ralph W. McKee has been appointed manager of Chas. A. Schieren & Co., Philadelphia, branch at 226 North Third St.

Thos. Brannan, who has just finished a five years engagement at the North American Building, Philadelphia, has been engaged by John R. Livezey, general sales agent for Nonpareil Cork Pipe Covering. Mr. Brannan is well known and popular, in which respect he is very much like cork. He will act as outside representative for Mr. Livezey and his success is assured.

A new catalogue has been issued by the Crandall Packing Co., Palmyra, N. Y. It contains 54 pages and many illustrations describing the different varieties of packing made by the firm. One of the special features of the Crandall packings is their patented cold air process of lubrication. Copies of the new catalogue may be had upon request.

Kruger & Blind, 513 Master St., Philadelphia, are now equipped to do all kinds of engine and dynamo repair work at short notice. They also build engines, boilers, belt pumps, heaters and separators. Write them for prices.

A sample can of Keystone Grease and a Keystone brass cup will be sent free to any engineer or steam user upon request, and the expressage is prepaid. At first sight this looks impossible, but the Keystone Lubricating Co., Twentieth St. and Allegheny Ave., Philadelphia, have been doing this for years, and have built up an enormous business. The reason is that nearly every person who sends for a sample becomes a regular customer, so you see, it's good business.

STEAM PUMPS for

If you wish a pump for feeding boiler, for tank service, for pumping beer, whisky, oil, milk, hot or cold water, condensations, vacuum, air, jet condensers,

WILL-NOT THE SHORT-STROKE
"GREAT BURNHAM"
Battle Creek, STEAM PUMP Mich. U. S. A.

EVERY SERVICE

hydraulic pumps, artesian or deep well engines, etc., etc., write address

"UNION"
BATTLE CREEK, MICH., U. S. A.

The Republic Rubber Company, of Youngstown, Ohio, are very jubilant over the increased demand for Searchlight Packing, which has exceeded their most sanguine anticipations. In this connection one of their representatives is quoted as saying:

"We naturally feel pretty good that Searchlight is so much in demand, which demonstrates that our efforts to put upon the market a strictly high grade packing are appreciated by packing users We knew that we had a high grade article in Searchlight, and that it would only be a question of time before others would 'fall in line.'"

The catalogues and other advertising literature issued by the manufacturers of steam plant apparatus are usually of a higher order than are those issued in other trades. That is, they are better illustrated, more instructive, more elevating and in every way more desirable. However, it is very doubtful if any catalogue in the steam field is of greater interest to a modern up-to-date power plant engineer than that of the Foster Engineering Co., Newark, N, J. No engineer who is desirous of keeping abreast of the times should be without a copy. A request mentioning THE PRACTICAL ENGINEER will bring you one. Write at once.

The unusually cold weather this winter has doubtless caused many engineers to regret that some of their steam and hot water pipes were not better protected, and very likely a good many resolutions have been made promising that the matter would not go over another summer, but the balmy summer breezes will produce forgetfulness in these matters. Anticipating as much, and in order to remind their friends of this much neglected feature, the Norristown Covering Co., Norristown, Pa., are publishing a new catalogue, which will contain a deal of interesting information about steam pipe insulation and will be a useful addition to any engineer's library. Send in your name and get a copy before they are all gone.

A. D. Granger Co., of 95 Liberty St., New York, are a firm of contracting engineers who erect complete power plants, including Steam and Electrical Transmission for Industrial and Manufacturing Projects, Hotels, Office Buildings, Apartment Houses, etc. A large and valuable portion of their business is in executing complete contracts under the specifications and supervision of the best consulting engineers. They are also agents for boilers built by the Union Iron Works, Erie, Pa., and the Harrisburg Manufacturing and Boiler Co., of Harrisburg, Pa. Their engines are built by the Skinner Engine Co., Stearns Manufacturing Co., and Erie Engine Works, of Erie, Pa., and the Bates Machine Co., of Joliet, Ill., embracing all kinds and types of engines from 5 to 2000 horse-power.

You Can Double Your Salary
—BY—
Selling Our Steam Specialties

We want men in every Manufacturing City in the Union. Our newer specialties accomplish more economies than anything heretofore introduced.

The prestage given them by their adoption as the Standard of Par-Excellence by the Leading Steam Users makes them comparatively easy sellers.

There are no samples to carry. WE WILL DOUBLE YOUR SALARY BY THE EXTREMELY LIBERAL COMMISSIONS WE PAY. Steam Specially Salesmen, Engineers, and all other who are in touch with Steam Power Plants are invited to correspond with us for terms.

THE WILLIAMS GAUGE CO.
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IF ENGINEERS will send $1.00 to the address below they will receive two blue prints, with tables and instructions, showing how to set valves and eccentrics on Corliss engines, simple and compound, with one and two eccentrics.
JOHN T. LINDSTROM,
214 and 216 S. 3d St., Allentown, Pa.

WANTED ENGINEERS... AND SALESMAN
To handle France "Steam Stopper" brands of Metallic and Fibrous Packing as a side line. Good inducements to right party. Address
FRANCE PACKING COMPANY,
TACONY, PHILA., PA.

MR. MANUFACTURER

Is it not your pride to operate your plant at as little expense as possible? Consider the cost of oil: Remember the CROSS OIL FILTER reduces the cost of oil one-half.

"By using the CROSS OIL FILTER we waste no oil except that which is unavoidably lost by splashing from the machinery"—The Willman Seaver-Morgan Engine Co., Cleveland, Ohio. We send the CROSS OIL FILTER on thirty days' trial. If unsatisfactory, return.

The Burt Mfg. COMPANY
Largest Manufacturers of Oil Filters in the world.
204 Main Street
Akron, Ohio, U.S.A.
FAIRBANKS CO.
Sole Agents for Philadelphia.

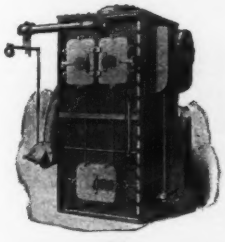
EVER FEEL of any perfectly **pure flake graphite?** It's the most marvellously smooth substance known to science. If you once feel of it you'll immediately understand its great value as a lubricant.

One practical test always makes practical men enthusiastic converts of "the better lubrication."

Write us today for Booklet 96c and a sample.

Joseph Dixon Crucible Co.
JERSEY CITY, N. J.

Cochrane Feed Water Heaters



"I must say that your heater does well and can keep the water constantly at 218 degrees with three pounds back pressure. As I am now able to use exhaust steam throughout the plant, I have made a saving of a little over two tons of coal in twenty-four hours and an average of $800 water rent per year for boiler feed, as I get all returns from condensed exhaust steam back to boilers."

We are constantly in receipt of letters like the above sample from users of our Cochrane Heaters, telling us of the very satisfactory service they obtain from these heaters and of the economies and savings which they are enabled to make. This is not surprising when it is remembered that we have over **two million horse-power** of these Cochrane Heaters in present service, and many of the largest steam users in all lines of industries all over the country use "Cochranes." Besides this, some of the warmest friends of the Cochrane Heaters are the leading mechanical and consulting engineers, who have had ample opportunity to demonstrate the efficiency of these Heaters, and who thoroughly endorse their design and construction.

Our Catalogue 16-H is sent free on request.

HARRISON SAFETY BOILER WORKS, 3144 N. 17th St., PHILADELPHIA, PA.

Manufacturers of Cochrane Feed Water Heaters, Cochrane Steam and Oil Separators and the Sorge-Cochrane Systems.

American Order of Steam Engineers.

ORGANIZED APRIL 27, 1886.

An Order of Engineesr for Engineers and Engineers only.

DECLARATIONS OF PRINCIPLES

Believing that ability will bring its full value in this country, this Order shall at no time take part in strikes, nor in any way interfere between employer and employees. Recognizing their identity of interests, it shall take no part in any project or enterprise that shall interfere with perfect harmony between them; neither shall it be used for political or religious purposes.

These principles shall not be amended or repealed except by unanimous vote of the Order.

Any member who shall be guilty of violating the principles of the Order shall be expelled.

OBJECTS.

First.—To promote a more thorough knowledge in its members of theoretical and practical steam engineering.

Second.—To assist members to obtain employment.

Third.—To help the sick, injured and distressed and bury the dead.

Fourth.—To establish a Widows' and Orphans' Fund.

Fifth.—To help members who shall become incapacitated from following the profession to obtain employment suited to their affliction.

Sixth.—To do our utmost to extend the license law throughout the United States.

Seventh.—To establish schools in which our members may study the highest branches of steam engineering.

MEMBERSHIP.

An applicant for membership must be an engineer between twenty-one and fifty years of age, and must be a white male citizen of the United States, of good moral character and be a believer in the Supreme Being, and be free from all physical infirmities.

He must have had three years' service in an engineering department, or if a machinist, or graduate of a technical institute, then one year's service, in such department, and in localities where engineers are required by law to be licensed, they must have such license, and must satisfy the investigating and examining committees of the council to which he applies as to his character and ability.

LIFE MEMBERSHIP.

Engineers who have passed the age limit may be admitted to life membership. They must possess the same qualifications and pass the same examination as are required in the next proceeding clause: They shall be entitled to all rights and privileges of the Order except they cannot vote on financial questions or for the election of officers or be entitled to any sick or death benefits.

DIRECTORY.

The Publication Committee of "The Practical Engineer" desires that the Corresponding Engineers of all Councils of the American Order of Steam Engineers send the name of their Chief Engineer and their own name and address, together with the time and place of meeting, to the Secretary of the Publication Committee immediately after each election of officers. Address, W. S. Wetzler, Secretary, 3717 Aspen St., Philadelphia.

SUPREME COUNCIL OF THE UNITED STATES.

Supreme Chief Engineer.—Noah R. Pierson, Fidelity Building, Baltimore, Md.
Supreme First Assistant Engineer—W. S. Price, Haddon Hall, Atlantic City.
Supreme Recording Engineer—C. W. Leng, 1556 East Montgomery Ave., Philadelphia.
Supreme Corresponding Engineer.—Jas. A. Stallings, 3006 Dillon St., Baltimore, Md.
Supreme Treasurer Engineer.—Geo. W. Richardson, 3728 Manayunk Ave., Wissahickon, Philadelphia.
Supreme Senior Master Mechanic.—A. Keppleman, 131 Buttonwood St., Reading, Pa.
Supreme Junior Master Mechanic.—Joseph T. Harris, 1611 Clybourn St., Milwaukee, Wis.
Supreme Inside Sentinel.—R. R. Taliaferra, Collingswood, N. J.
Supreme Outside Sentinel.—Samuel Logan, Wilmington, Del.
Supreme Chaplain.—C. H. Pfeiffer, Camden, N. J.

SUPREME TRUSTEES.

C. P. Williams, Penn.; A. M. Plummer, N. J., and Wm. J. Mitchell, Delaware.

PAST SUPREME CHIEF ENGINEERS.

Jerry Leahey, Jr., Harry G. Connor, Clifford P. Williams, Geo. W. Richardson, Fred. W. Moore, Jas. Lightfoot, J. T. Dodge, Jr., Franklin R. Moore, J. C. McDowell.

DELAWARE.

Deputy Supreme Chief Engineer, David J. Stayton, No. 513 Searles St., Wilmington.

WILMINGTON.

Delaware Council, No. 1, meets every Wednesday at S. E. Cor. Fourth and King Sts. Corresponding Engineer, A. E. Deakyne, 406 Lombard St.

LOUISIANA.

JENNINGS.

Jennings Council, No. 2, meets every Saturday evening in American Bank. Corresponding Engineer, R. E. Funk.

MARYLAND.

Deputy Supreme Chief Engineer, A. J. Deidrich, 226 North Caroline St., Baltimore, Md.

BALTIMORE.

Maryland Council, No. 1, meets 2nd and 4th Fridays in Royal Arcanium Hall. Corresponding Engineer, John J. McKewen, 115 N. Ann St.

Energy Council, No. 2, meets every Wednesday of each month in Bauer Hall, Chesapeake and Elliott Sts. Corresponding Engineer, Phillip Kirkwood, 204 S. Washington St.

MASSACHUSETTS.

Deputy Supreme Chief for Eastern District, W. E. Packard, Whitmann.

ROCKLAND.

Old Colony Council, No. 14, meets 2nd and 4th Saturdays in the American Foresters' Hall. Corresponding Engineer, Walter A. Randall, Abington, Mass.

NEW JERSEY.

Deputy Supreme Chief, Joseph H. Wheatley, 421 S 5th St., Camden, N. J.

PERTH AMBOY.

Stevens Council, No. 1, meets 3rd Saturday, at Water, near Lafayette St. Corresponding Engineer, James H. White.

CAMDEN.

Camden Council, No. 3, meets every Thursday evening at S. E. corner 2d and Arch Sts. Corresponding Engineer, C. H. Pfeiffer, 571 Berkley St.

ATLANTIC CITY.

Atlantic City, No. 4, meets every Tuesday evening at Merchants, Cor. Atlantic and New York Aves. Corresponding Engineer, W. S. Price, Haddon Hall.

MILLVILLE.

Millville Council, No. 6, meets every Saturday, 7.30 P. M., in G. A. R. Hall, East Main St. Corresponding Engineer, Lewis Doughty, 604 Mulberry St.

PENNSYLVANIA.

Grand Chief Engineer, Hiram Trout, 1042 Locust St., Reading, Pa. Deputy Grand Chief for Philadelphia and Delaware Counties, John P. Rickards, 2707 N. Broad St., Philadelphia. Grand Corresponding Engineer, Frederick Markoe, 931 Orianna St., Philadelphia.

Deputy Grand Chief for Western Pennsylvania, A. D. Hamilton, 2025 Forbes St., Pittsburg, Pa.

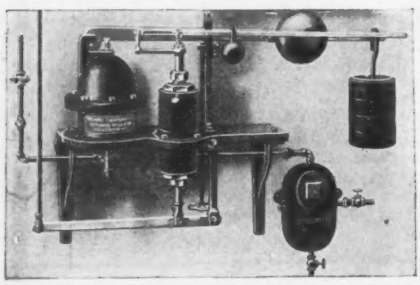
PHILADELPHIA.

Germantown Council, No. 22, meets every Wednesday evening at Main and Seymour Sts., Germantown. Corresponding Engineer, Frank MacIndoe, 3519 Ainsley St., Falls of Schuylkill, Philadelphia.

Kensington Council, No. 3, meets every Thursday, at A. P. A. Hall, Frankford Ave. and Master St. Corresponding Engineer, Geo. W. Kennedy, 2052 East Fletcher St.

Southwark Council, No. 4, meets every Monday, at Cor. of Reed and Eighth Sts. Corresponding Engineer, J. C. McDowell, 1913 South Eighth St.

Philadelphia Council, No. 7, meets every Wednesday, at Kenny's Hall, N. W. Cor. Broad and Filbert Sts. Corresponding Engineer, W. S. Wetzsler, 3717 Aspen St.



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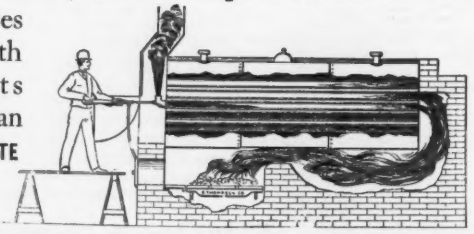
Damper Regulators with
Latest Improvements
Tube Cleaners that Clean

SHAKING, DUMPING AND STATIONARY GRATE BARS FOR ROUND AND SQUARE FURNACES, AND ALL GRADES OF FUEL.



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Richard Thompson & Co., 124 Liberty Sireet, NEW YORK, N. Y.

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Homestead Valves

are demanded in all four quarters of the globe

We will impart the secret to you. They are higher priced and very much better than the ordinary kind for all *HARD-TO-FILL* places.

Write for Booklet No. 10, just issued.

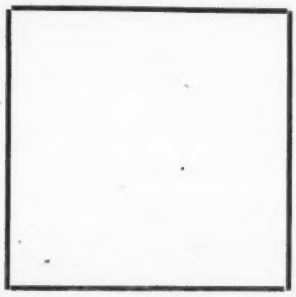
Homestead Valve Mfg. Co.

Box 1754, Pittsburg, Pa., U. S. A.

Works at Homestead, Pa.

GIVE IT A TRIAL

ANTI-FRICTION



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? What's Missing ?

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LARKIN'S PACKING

But you'll be missing if you don't work for the interest of your Employer. Ask us

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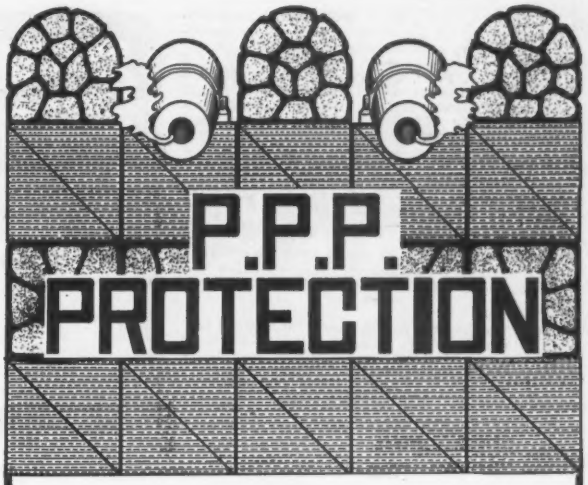
BROTHERS FREUND, VIENNA, III, MARXERGASSE 4 (CONTINENTAL EUROPE).



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is guaranteed all engineers that will use Daniel's P. P. P. This is because P. P. P. is the only packing combining perfect elasticity in the packing itself with the sliding wedge action. As a result of this combination the packing produces friction only during that part of the stroke when friction is necessary to effect a steam tight condition. An investigation into the merits of

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Municipal P. F. D. Council, No. 20, of Philadelphia, meets the second Thursday of each month at Odd Fellows' Hall, Third and Brown Sts. Corresponding Engineer, Walter Meyers, 1211 North Howard St.

PITTSBURG.
Iron City Council, No. 21, meets every Saturday at Arnfeld Hall, 1119 Penn Ave. Corresponding Engineer, Alex Fraser, Carnegie, Pa.

ALLENTOWN.
Lehigh Council, No. 15, meets every Wednesday evening at 639 Hamilton St. Corresponding Engineer, A. P. Driesbach, 728 Chew St.

POTTSTOWN.
Pottstown Council, No. 14, meets 1st and 3rd Saturday evenings at P. O. S. of A. Hall, Cor. High and Hanover Sts. Corresponding Engineer, H. L. Shirey, 362 Cherry St.

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Progress Council, No. 12, meets every Saturday evening at Diebert Hall, Ninth and Penn Sts., Room 4. Corresponding Engineer, Frank S. Miller, 3 West Franklin St.

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York Council, No. 16, meets every Wednesday Evening in the Jordan Block. Corresponding Engineer, Walter H. Long, 23 East Philadelphia St.

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Columbia Council, No. 18, meets every 1st and 3rd Saturdays, in Odd Fellows' Hall. Corresponding Engineer, W. J. Courtney, 804 Walnut St.

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Sunbury Council, No. 19, meets every Monday evening in Zartman's Hall. Corresponding Engineer, Ed. Schrieber.

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Deputy Supreme Chief Engineer, Joseph T. Harris, No. 1611 Clybourn St., Milwaukee.

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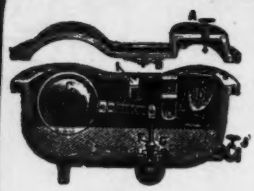
Clifford P. Williams Council, No. 2, meets every Monday evening at Lodge Hall, E. Water St. Corresponding Engineer, Joseph T. Harris, 1611 Clybourn St.



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Requires LESS steam than any other cleaner.
Will positively clean BETTER than scraper or brush.
Will clean ANY length tube.
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Is the LIGHTEST and EASIEST cleaner to handle.
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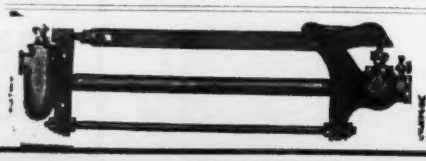

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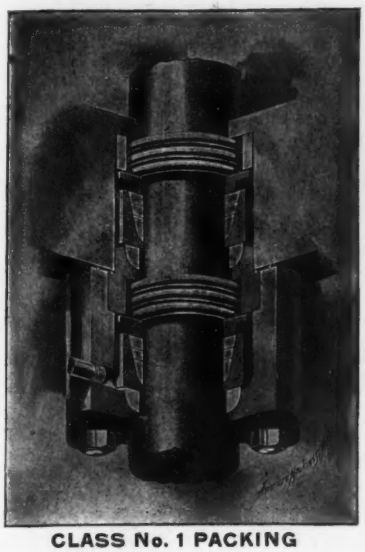

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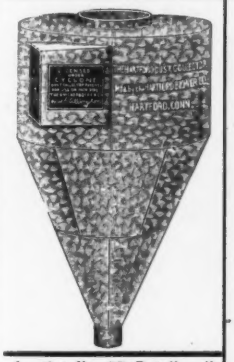

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will obviate the nuisance.

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No Back Pressure!
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A centrifugal exhaust head without a single battle plate or partition. All sizes in stock up to 12 inches. Larger sizes shipped one to two days after receipt of order.

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is very essential to best results in connection with a modern Steam Plant. The "Standard" is built on lines that make it absolutely positive when properly connected. They will always count forward with rotary motion either right or left; also reciprocating, and are made in both round and oblong cases.

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Weinland Tube Cleaner

AND YOU CANNOT MAKE A MISTAKE

We have them for all styles Boilers and all sizes of Tubes. This Turbine Cleaner is an excellent machine. Hosts of satisfied users testify as to this.

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Lagonda Reseating Machine

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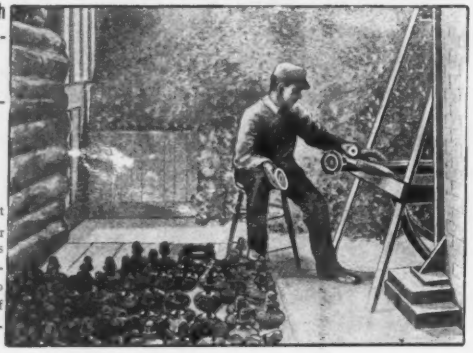

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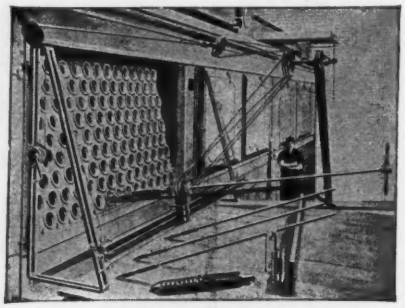
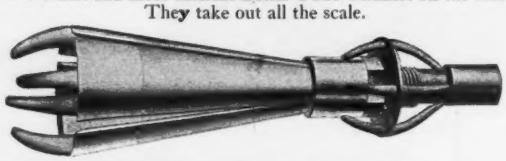


The Union Boiler Tube Cleaners

POWER OR IMPULSE

Are the oldest and most efficient Boiler Tube Cleaners on the market. They take out all the scale.



The Gem Flue Scraper

does the same for Smoke Flue Boilers

We also make **Gem Oilers**, Patent or Plain, **Torches and Heavy Brazed Steel Oilers, Flexible Shafting, Loose Pulley Lubricator.**

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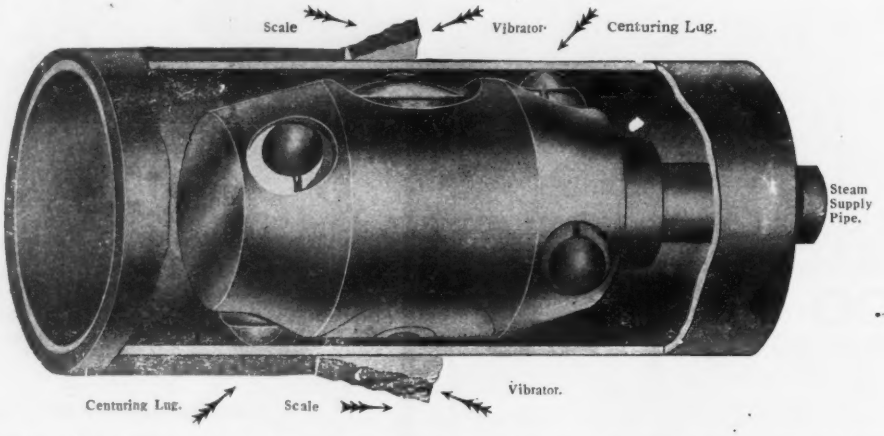
The "Torpedo" Has Exploded

all of the old ideas regarding the cleaning of fire tube boilers, and will prevent the explosion of many boilers by keeping them free of scale



A rapid vibration does the work. Is it not better to give the tube many short and light raps than to apply slow and heavy blows? The "Torpedo" is built upon a correct mechanical principle. It embodies the latest and most approved ideas for fire tube cleaners, and is recognized by experts as containing improvements absolutely essential in the light of present day knowledge. We can, if you wish, refer you to many of delighted users, but it would be more satisfactory to you if you witnessed its work in your own boilers. If you desire to see what a machine perfect in principle and operation can do for you, then we suggest that you take advantage at once of our free trial offer. Catalogue and prices for the asking.

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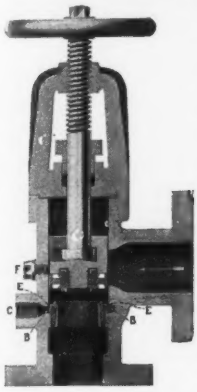
Boiler Tube Cleaners
Blow-off Valves

The Liberty Turbine Boiler Tube Cleaner

will clean tubes more thouroughly, at less cost, and in less time than can be done by other means.

This we guarantee.



We also make the **Niagara Turbine Tube Cleaner.** We have suit for infringement of patents against a user of the Weinland machine, and will sue all other infringers

The Faber Blow-off Valve

washes its face every time it is opened and closed.

A connection at C admits steam at boiler pressure to chamber B, whence it escapes through slot E all around the seat, and sweeps both seat and disk free from sediment just before closing. It will last as long as a steam valve without leaking.

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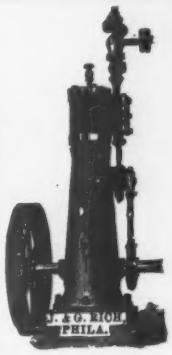

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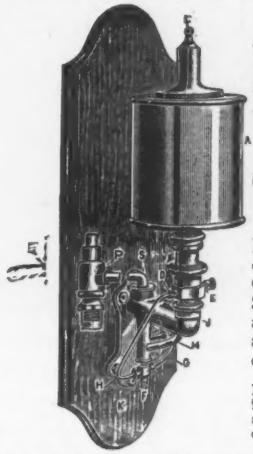

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Kellam Damper Regulators

The Simplest and Closest Damper Regulator.

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Brass Founders and Finishers and Makers of Pop Safety Valves, Water Relief Valves, Oil Cups and Lubricators, Steam Pressure Regulators and other safety steam appliances.

Old Kellam Regulators Repaired. Correspondence Solicited. Mention this paper if your inquiry is prompted by the sight of this advertisement. Catalogue D free on application.

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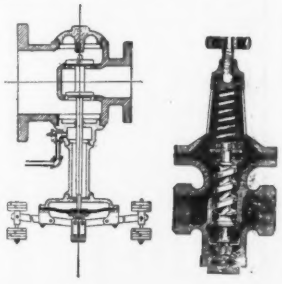

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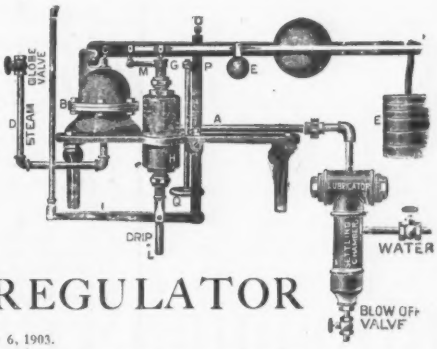

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Situations secured for good engineers and firemen.

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And *No Charge* to the man unless he secures the situation.

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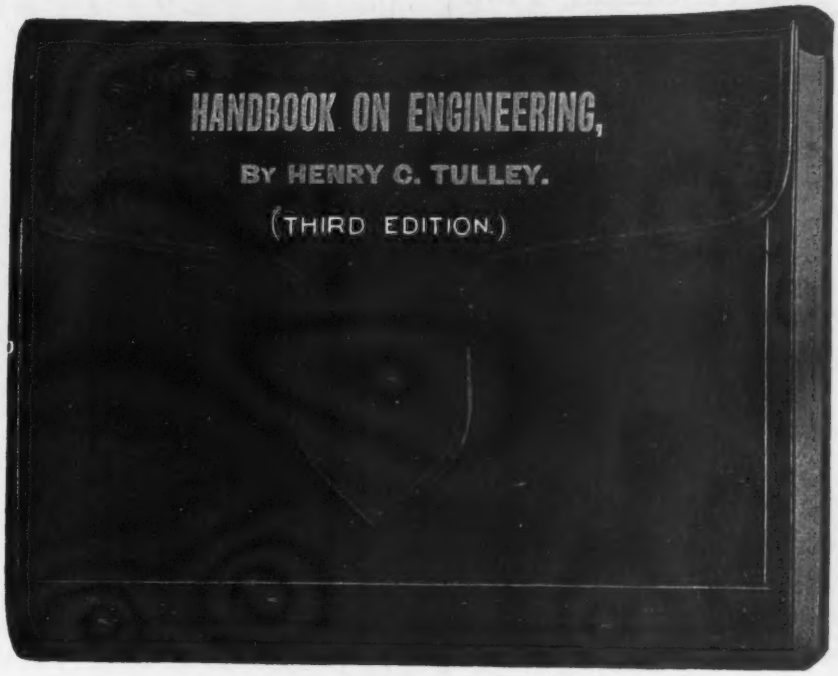

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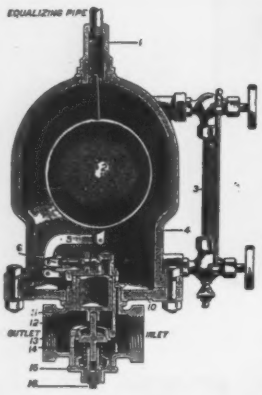

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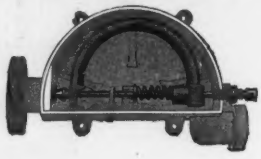
and no failures, but more than a hundred thousand sold a year. Can any other steam trap in the world point to the record.



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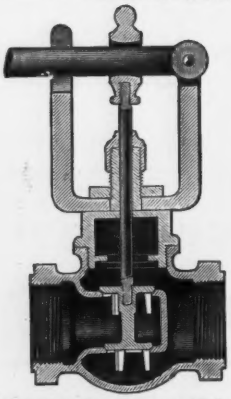
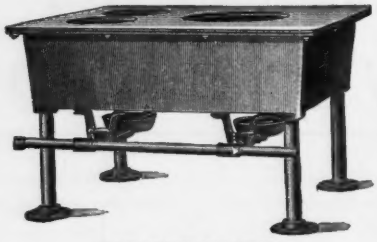
For Pressures under 70 Lbs.

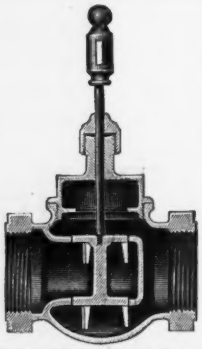


Quick Opening Balance Valve

STEAM GLUE HEATER



GAS GLUE HEATER



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For Pressures 70 to 150 Lbs.

High Pressure Vertical Tube Radiator

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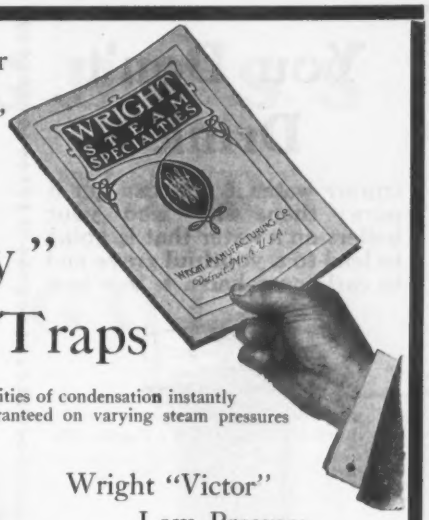

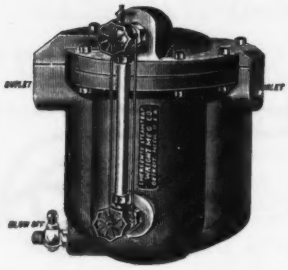

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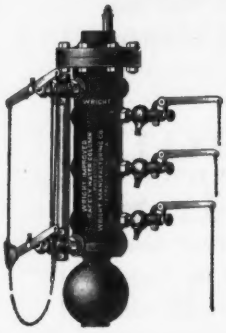
The only steam trap made that will dispose of large quantities of condensation instantly in emergencies and waste no steam. Successful operation guaranteed on varying steam pressures up to 250 pounds.



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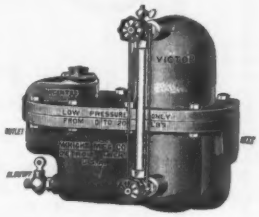
Careful buyers give Wright's Columns the preference, because they are the simplest in design, never get out of order and never fail.



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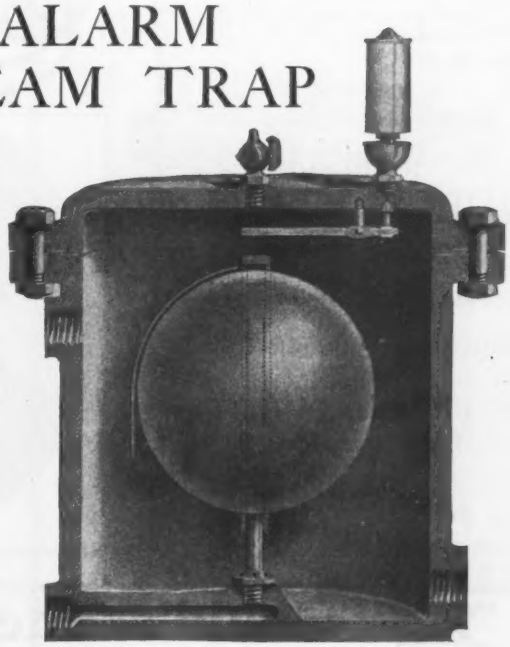
FIRST—A Steam Separator that will separate the water from the sterm before it leaves the boiler. The Separator here shown is placed inside of the boiler directly under the steam outlet to the engine, and is guaranteed to reduce the moisture to three-quarters of one per cent.

SECOND—A Steam Trap. The Trap shown here is simple in construction and effective. **A commendable feature is that it has no packing, of any kind, the cover being ground steam tight. Another feature is, that it has a Safety Alarm.** This is one thing which is needed as sometimes the traps get clogged up by impurities, and at such times **this Trap** will give notice and **save damage** to machinery.



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All types and sizes of Steam Engine Cylinders, Valve Pockets, Pumps, and Air Compressors Rebored in present position, from 4 to 76 inches.

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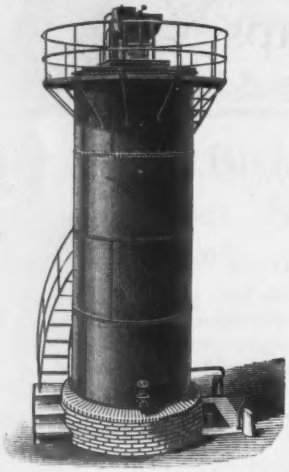

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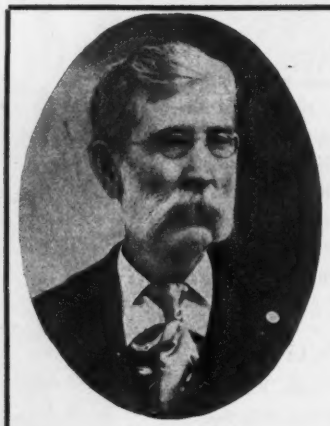

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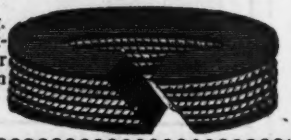

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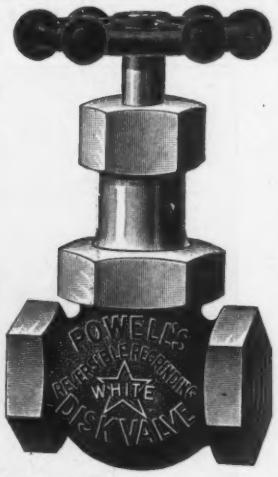

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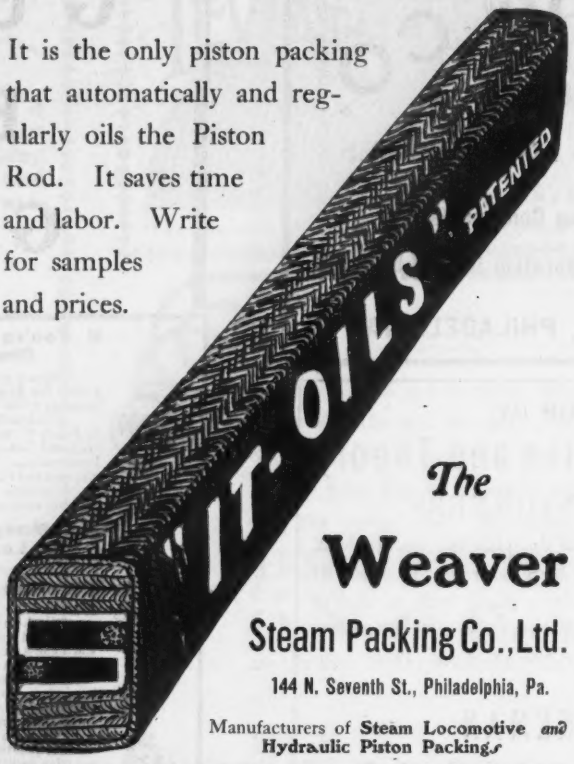

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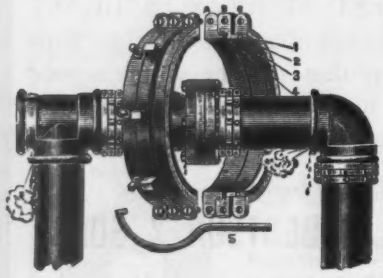

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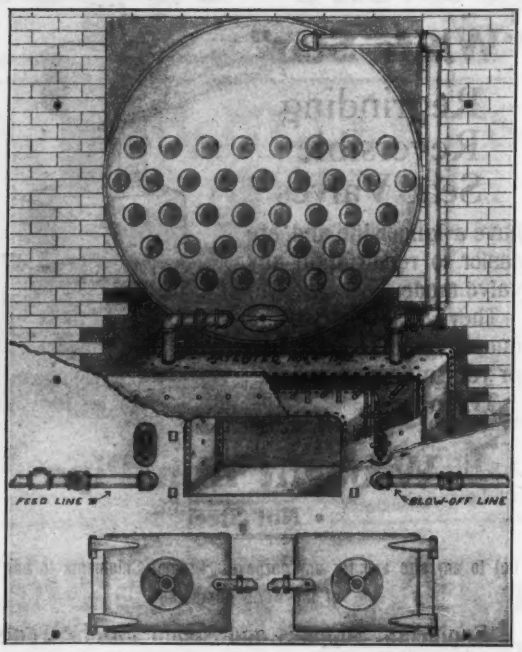

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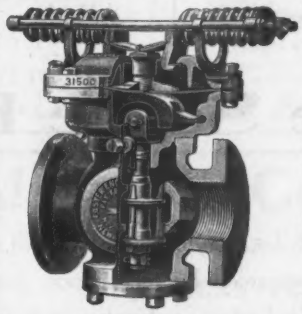

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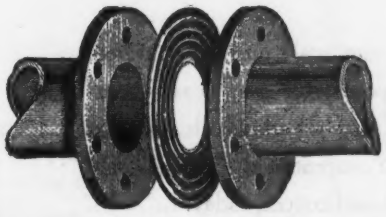

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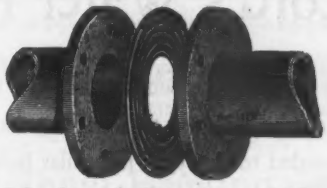

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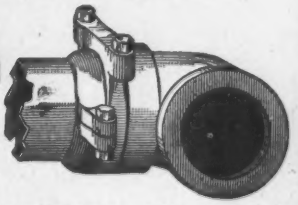

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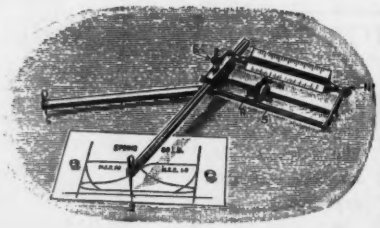

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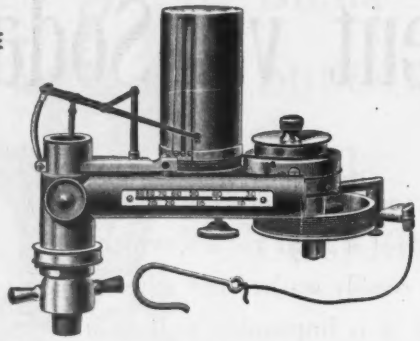

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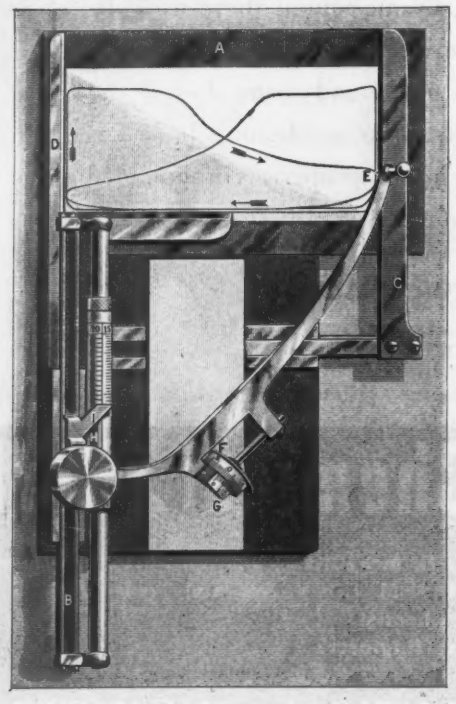

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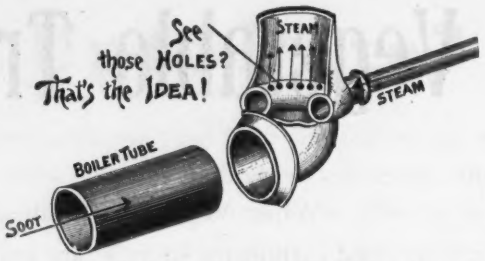

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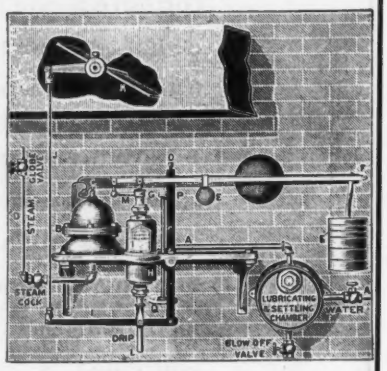

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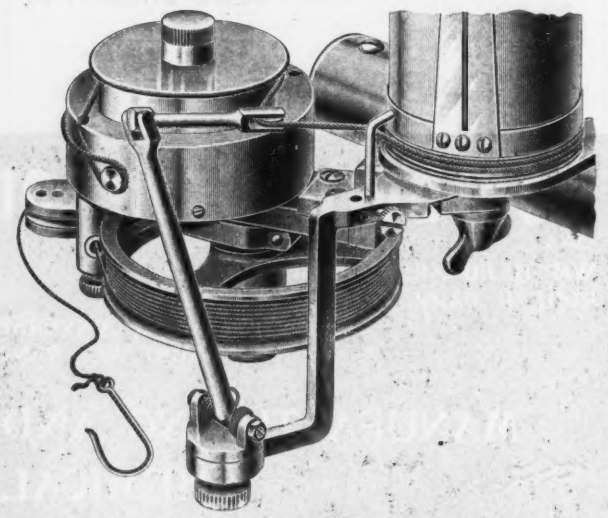

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"You get your smoke"

Just read what an engineer says about

STEPHENSON BAR BELT DRESSING

Rochester, N. Y., Feb. 7, 1904

Stephenson Mfg. Co., Albany, N. Y.

Gentlemen: I received your sample and should have written you before but I waited for a chance to convince my employer that your Dressing is better than the liquids.

We have a two ton elevator.

I bet him a cigar I could load the car with Strawboard up to the crossbeam and the Dressing would talk for itself. He said, "that's a go". So I put on the load and told the boys to start her up. When she got to the top the boss looked at me and said, "you get your smoke."

I am very much pleased with your Dressing. Have been engineering thirteen years, and it is the O. K. goods. I have saved your card and as the can of stuff is used up the boss says I can have some of yours.

Yours very truly,
A. KLIPFEL, Engineer.

Are YOU willing to be convinced that you are NOT using the best Dressing on the market, unless the name Stephenson is on each pound stick? If so, upon request we will send you a free sample if you mention this paper.

STEPHENSON MFG. CO.
ALBANY, NEW YORK

NO RISK WITH

Patterson Specialties

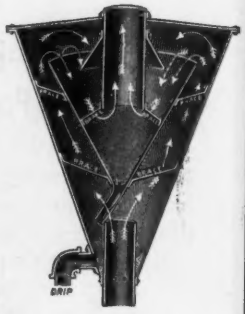
(IMPROVED TO DATE)

YOU CAN TRY THEM SIXTY DAYS AT OUR EXPENSE

No need to say much here about

Patterson Berryman Heaters

Because they have so many old friends.



Put on a

Patterson Exhaust Head

and have a clean roof. Get rid of the greasy spray.

Look at that hand hole. Easy to clean a

Patterson Separator or Oil Extractor

We wish every one appreciated how much cheaper it is to feed a boiler with a belt pump than any other way.

Patterson Pumps

would sell faster than ever.

PLEASE let us know if you are interested. Our proposition is SO reasonable.

WE WANT A FEW MORE GOOD AGENTS

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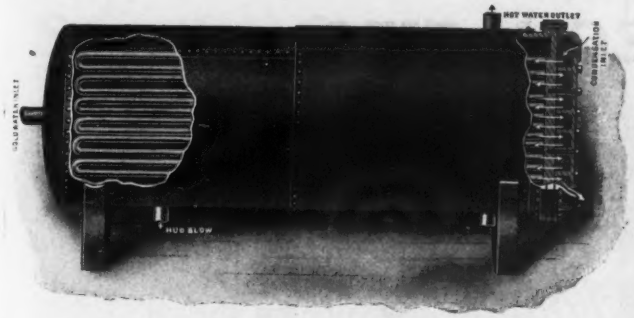
24 Cortlandt Street - NEW YORK, N. Y.



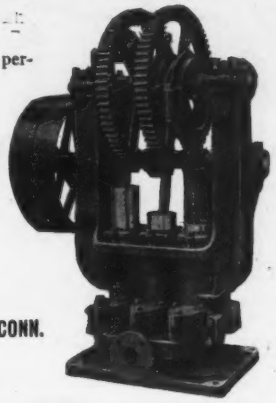
THE GLEANER TRADE MARK

The **Gleaner** represents the acme of perfection in feed water heating.

THE

Davis Triplex Power Pump

is a perfect type of the vertical triplex belt driven pump.



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The "Berryman" Feed Water Heater and Purifier.

I. B. DAVIS & SON, HARTFORD, CONN.

WRITE FOR CATALOGUE, ETC., TO

THOS. McADOO, 125 N. 4th St., Philadelphia

THE OTIS Tabular Feed WATER HEATER, OIL SEPARATOR and PURIFIER

with Seamless Brass Tubes

Guaranteed

To heat the feed water to the boiling point (210 or 212 degrees) with the exhaust steam without causing any back pressure, **also to extract the oil from the exhaust,** so that the exhaust steam after being passed through the heater can be used for heating purposes, and the water of condensation for the heating system be returned to the boiler without the additional expense of an eliminator.

A Liberal Offer

If this heater fails to give satisfaction in every respect, we pay freight, cartage, etc., both ways.

The Stewart Heater Co.

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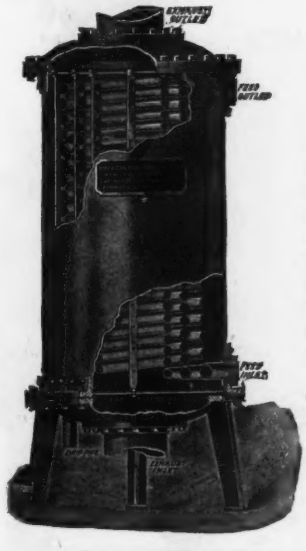
THE AMERICAN STANDARD COPPER COIL FEED WATER HEATER



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Strength!
Economy!
A Money Saver!

It gives so little trouble that one of our customers, who has used one for three years, had forgotten that he had it when we asked him the other day how it was doing. He called in the engineer, who said it hadn't been touched since it was put in and was still heating the water to 210 degrees.

That's the kind of a Heater you want.

Write for Catalogue No. 100 P

The Whitlock Coil Pipe Co.

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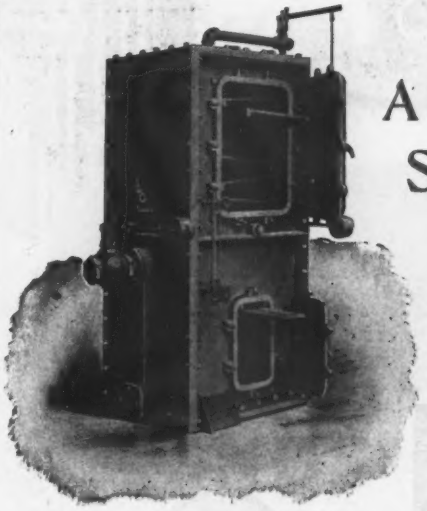

A SHORT STORY

"Thoroughfare" heater. Engineer forgot to open escape valve. By-pass was closed. Engineer opened inlet valve. Bang! Heater blew up.

WEBSTER FEED-WATER HEATERS AND PURIFIERS

not being "throughfare" heaters, are safe from such accidents. Then, as they use only just enough steam to heat the feed-water to the boiling po nt, they are unequaled for economy.

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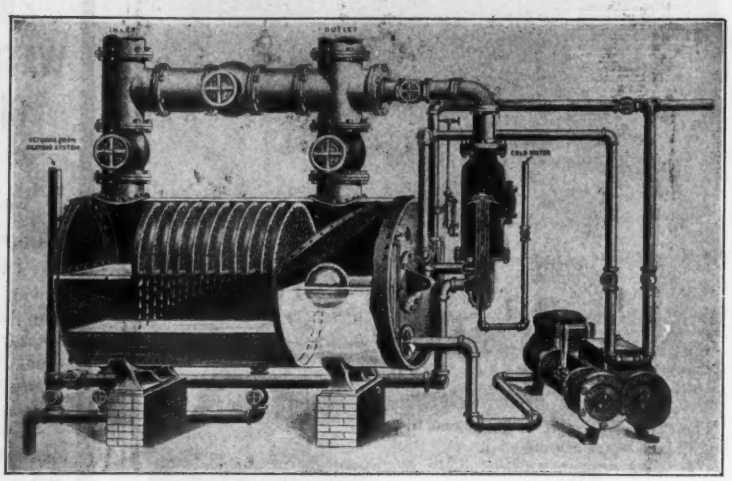
"Utility" STEAM SPECIALTIES

WE POINT TO WHAT WE'VE DONE AS PROOF THAT OIL CAN BE ENTIRELY REMOVED FROM EXHAUST STEAM AND THAT FEED WATER CAN BE HEATED ABOUT TO THE TEMPERATURE OF THE EXHAUST BY

Our "Utility" Combination

We can always guarantee an elimination of 98 per cent. at the outlet point af separator. We average over 99 per cent and have in some cases left but 8-10,000 of 1 per cent. of oil in the water. You can't see this amount, you can't taste it; fresh well water frequently has more oil in it, and this water can be used for fifty years in boilers without showing a trace of oil deposit. The feed water heating feature is optional, but very efficient, free from back pressure and requires but little room and no floor space.

The "Utility" Combination serves as Exhaust Muffler, Oil Separator, Return Tank, Pump Governor and Feed Water Heater. It costs only about as much as a Feed Water Heater.



"Utility" Pump Governor

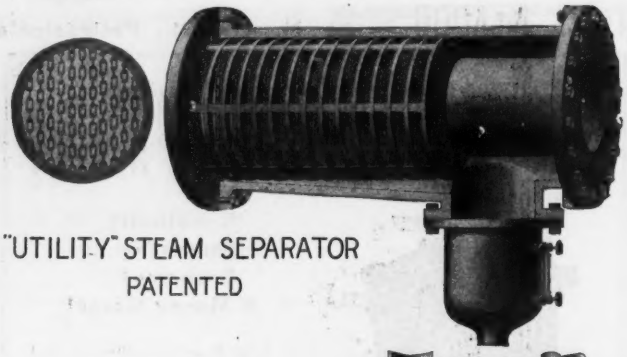
The best Pump Governor on the market. Why? Because our valve will not leak or stick; we guarantee it to absolutely govern the pump and remain tight for five years. Compare the construction of our valve with any other on the market. By adopting the "Utility" you can save coal and get a higher temperature from your heating or drying systems. Send for catalogue and list of users.

A New Application

of the chain baffle plate principle which has proven so successful in the oil eliminator may be found in our

Steam Separator

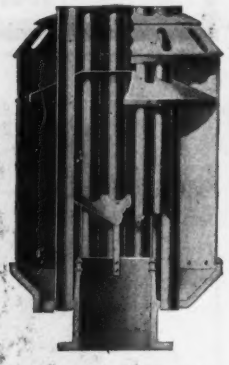
and the efficiency of it is very high. Absolutely dry steam, absolutely no back pressure. What more could you ask?



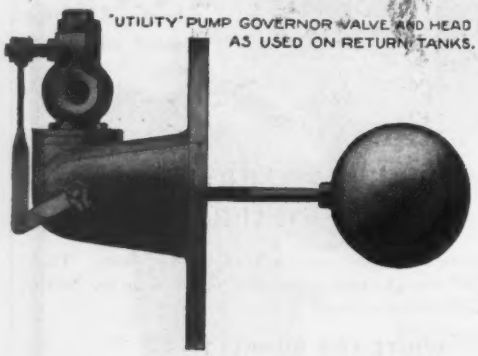
"UTILITY" STEAM SEPARATOR PATENTED

Another Water Saver

is our new Exhaust Head. Notice the great radiating surface that is given by the CIRCULATING AIR TUBES. These act as condensers, and they lessen instead of causing back pressure. Do you realize that a thousand gallons of water are wasted in a moderate sized plant which lacks an efficient exhaust head? It's so.



UTILITY EXHAUST HEAD PATENTED



"UTILITY" PUMP GOVERNOR VALVE AND HEAD AS USED ON RETURN TANKS.

WE ALSO CARRY IN STOCK

- Back Pressure Valves
- Blow-off Cocks
- Pressure Reducing Valves
- High and Low Pressure Boiler Feeders
- Reducing Pressure Reducing Valves
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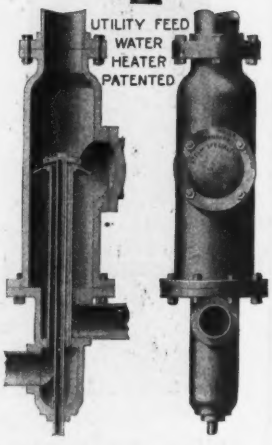
- Steam Traps
- Damper Regulators
- Feed Water Controllers
- "Utility" Beam Clamps



UTILITY FEED WATER HEATER PATENTED

Standard Steam Specialty Co.

542 and 544 WEST BROADWAY
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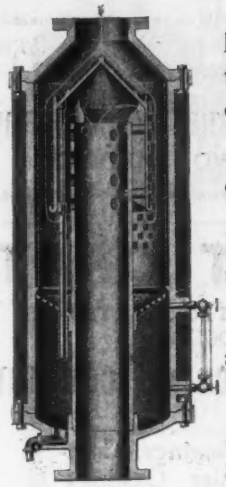
Sweet's Separators



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Our oil separators remove 99 per cent. of the oil.

We can prove they do it and give good reasons why.

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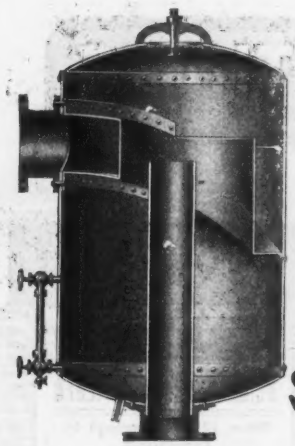
THAT BY USING A WELL DESIGNED AND PROPORTIONED STEAM RECEIVER AND SEPARATOR

YOU COULD



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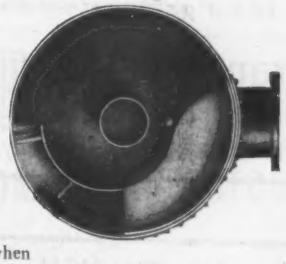

OVERCOME entirely any chances of damage to your Engine by water throwing over with the steam.
SECURE better cylinder lubrication with less oil.
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SECURE approximately boiler pressure in engine cylinder.
INCREASE engine power by securing these advantages.
At the same time **NOT INTERFERE WITH THE FREE FLOW OF STEAM FROM THE BOILER.**

The above advantages can be secured only when

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IMPROVED

Steam Receiver and Separator

IS USED, as each is proportioned and built for the exact conditions under which it is to operate.

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"Steam Stopper"
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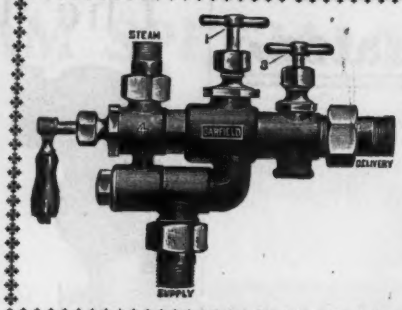

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Boilers steam easily and engines run smoothly.

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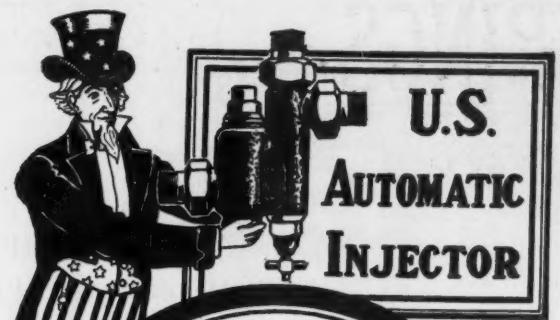

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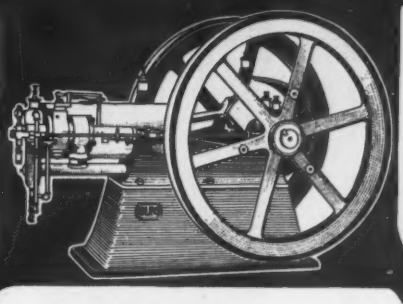

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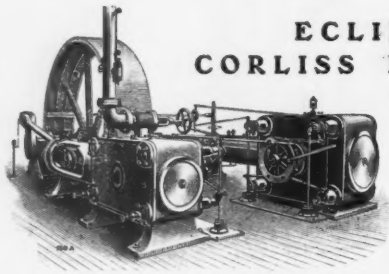

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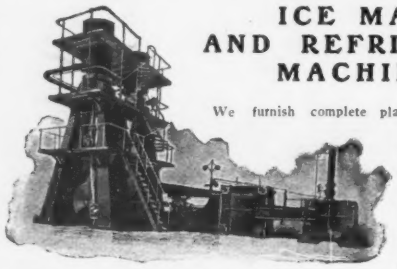

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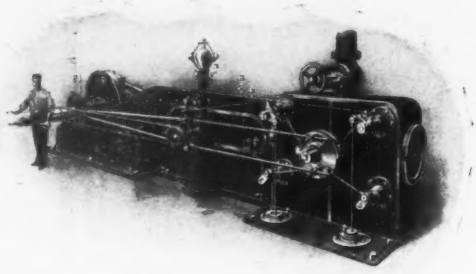

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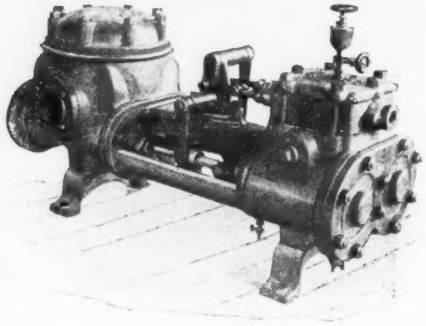

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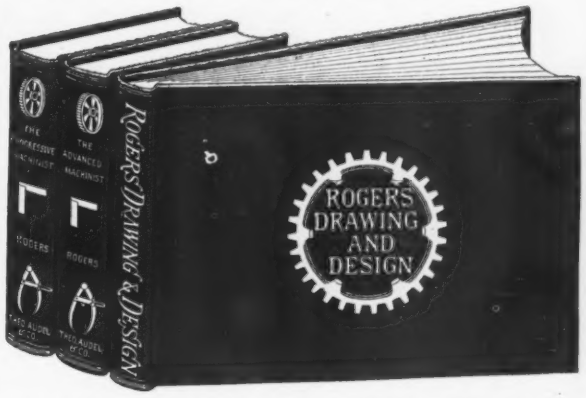

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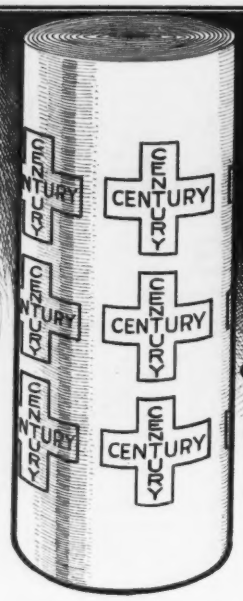

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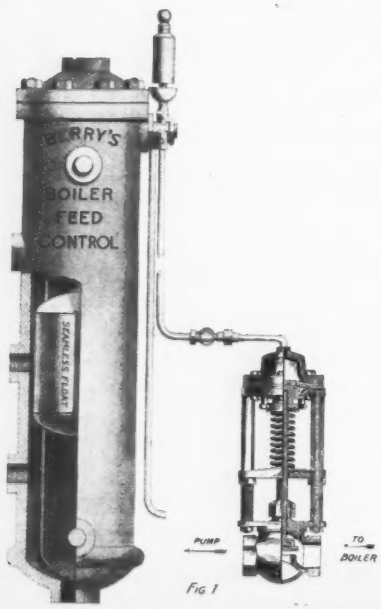

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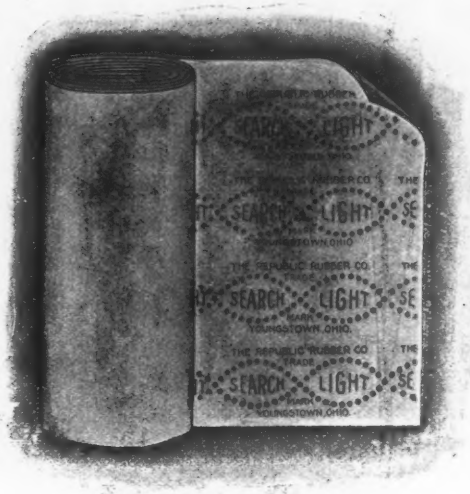

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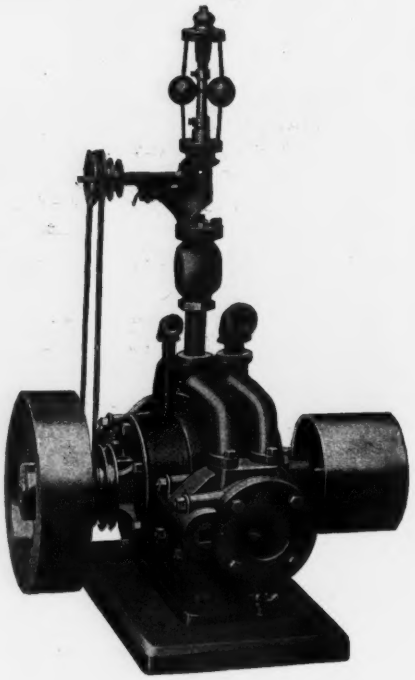

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